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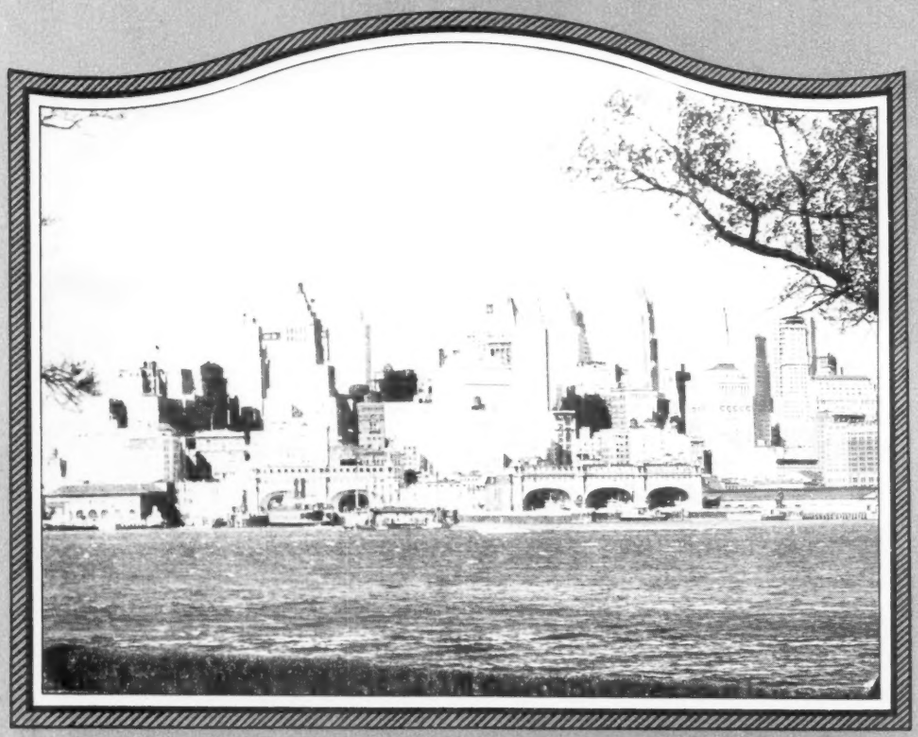

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LOWER MANHATTAN'S IMPRESSIVE SKYLINE IS ALWAYS A CAUSE OF WONDERMENT TO NEWCOMERS ENTERING THE PORT OF NEW YORK

Producers of Pink Granite for Six Decades
R. G. Skerrett

Oil-Engine Drive Adopted for Suction Dredge
C. H. Vivian

Mount Hope Bridge Example of Modern Engineering
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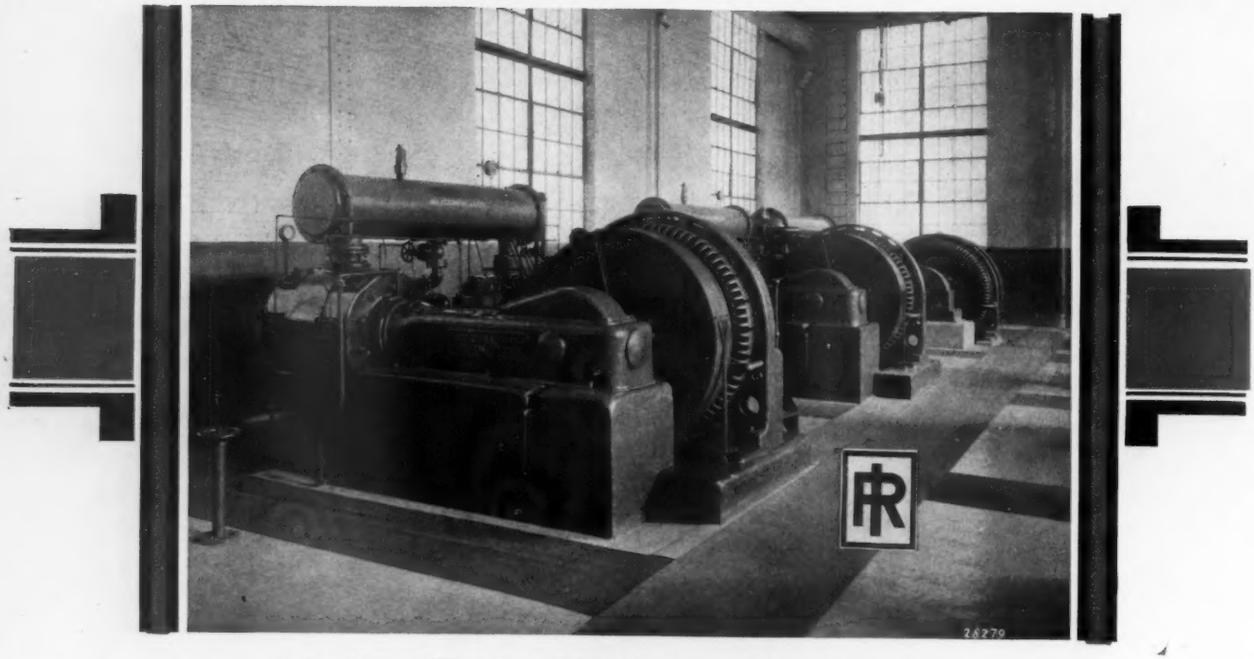

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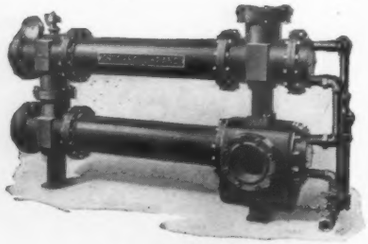

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Mount Hope Bridge Fine Example of Modern Engineering

Structure Completes Highway Between Providence and Newport and Contains a Number of Noteworthy Features

By S. G. ROBERTS

MOUNT Hope Bridge, across Mount Hope Bay in Rhode Island, is scheduled to be ready for service in the course of the next month or six weeks. This bridge closes a break in a motor highway running from Providence to Newport over which many thousands of motor vehicles travel annually and especially during the summer season to and from that well-known and fashionable seaside resort.

In the case of the Mount Hope Bridge, private capital has stepped in and provided a structure where the state, because of other pressing demands upon its funds, could not see its way to erect a bridge even though a state commission had reported that traffic was ample enough to justify such a toll undertaking. The public will be the immediate beneficiaries of this private enterprise that should pay well for itself in good time. The legislature of Rhode Island granted to the promoters permission to go ahead as recently as April of 1927; and that the structure will be ready for use shortly is the best evidence of the promptness with which action has followed.

The state had contemplated a cantilever bridge estimated to entail an outlay of $6,000,000. The structure that has been built by the Mount Hope Bridge Company is a wire-cable suspension bridge calling for the obligation of $4,250,000; and while the legislative authority stipulated that the bridge should be finished by 1931, the company's contract set July 1, 1929, as the date for completion. The general contractors are the McClintic-Marshall Construction Company, who have provided the steel superstructures; and the McClintic-Marshall Construction Company have, in their turn, sublet other parts of the work to various responsible concerns especially fitted to deal with particular departments of this fine undertaking.

2745

MOUNT Hope Bridge is an impressive monument to the rapidly increasing automotive traffic of the Nation. It is cumulative evidence of the way in which popular demand is cutstripping the capacity of the public purse to supply conveniences of this sort.

Private enterprise and private capital have done what Rhode Island did not feel that she could do despite the fact of ample warrant for the construction of a bridge across Mount Hope Bay for the purpose of spanning a water gap in the much used highway extending between Providence and Newport.

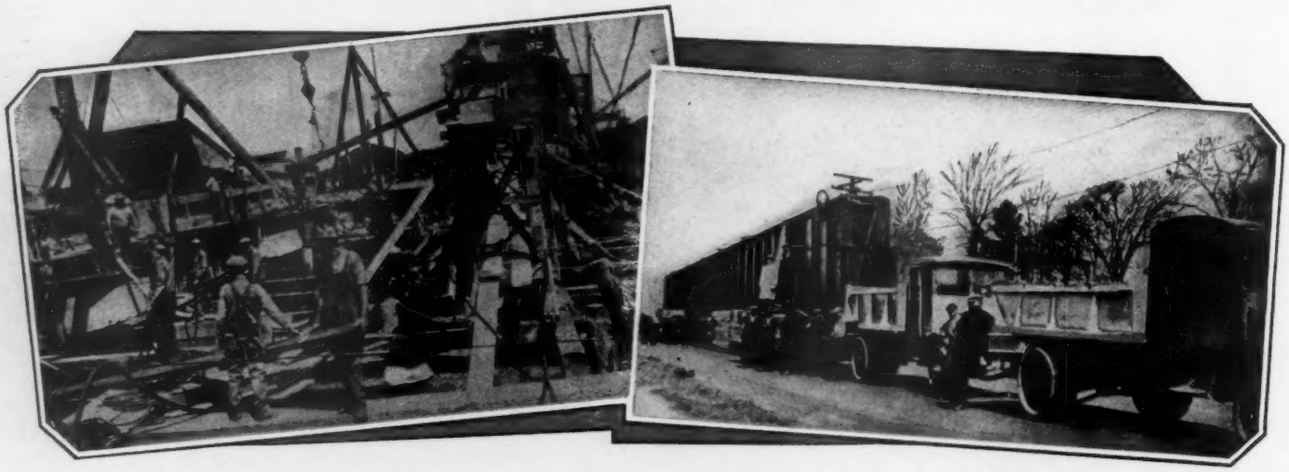
The taxpayers of the state have been saved a levy of $4,250,000, while the motoring public has obtained a splendid toll bridge that can be used, with a great saving of time, at all seasons and under all conditions of weather—something that could not be claimed for the long established ferry line that previously served as the connecting link.

The Mount Hope Bridge is a noteworthy engineering undertaking; and its completion will establish a precedent that other states may find it wise to follow.

As an accompanying map shows, Mount Hope Bay lies to the eastward of Narragansett Bay, and the Mount Hope Bridge spans the narrow mouth of Mount Hope Bay where the opposite shores are rather flat and separated by a waterway 2,820 feet wide. While the main channel is nearly 88 feet in depth at mean low water, still much of the water spanned is shallow, and this has necessitated the erection of numerous piers, 100 feet apart, of which a considerable number are located offshore. Generally speaking, the line of the bridge is in a north-and-south direction; and the entire structure is 6,130 feet in length between approaches. The main span is 1,200 feet long, with an adjoining span at each end 504 feet in length and with viaduct approaches totaling 3,922 feet.

Before describing the bridge in further detail, it might be of interest to point out that the structure takes the place of a ferry line that has heretofore been the only connecting link between the neighboring shores, and the operation of which has been seriously hampered and even halted at times owing to weather conditions. The Bristol Ferry, which the bridge supplants, was first established by the early settlers as far back as 1680, and was for the purpose of facilitating traffic between the towns of Newport and Portsmouth and Providence and Boston. It was by way of Bristol Ferry, in those historic days, that the royal postriders crossed Mount Hope Bay when carrying His Majesty's mail between New York and Boston; and it is recorded that subsequently Generals Washington, Lafayette, Rochambeau, and Sullivan, as well as other distinguished men, used the same route when the Nation was in its formative period.

Mount Hope Bridge will serve to connect Providence, or Providence Plantations—settled by Roger Williams in 1636, with the island of Rhode Island that was originally called Aquidneck when purchased from the Indians and settled by John Clarke in 1638.



Left—Pouring concrete at the Portsmouth anchorage. Right—Manner in which the 150-foot girders were moved through the streets of Bristol.

The Wampanoag Indians lived in southeastern Massachusetts and nearby Rhode Island; and King Philip, a chief of that powerful tribe, lived on the slopes of Mount Hope within view of the site of the present bridge. There, so it is said, he planned the attacks which devastated the neighboring white settlements in 1675 and 1676. King Philip was shot by one of his own people at Mount Hope, and his grave there bears testimony to that tradition. The death of King Philip dispelled happily for all time the recurrence of the horrors of Indian warfare. The Mount Hope Bridge, therefore, rests upon historic ground.

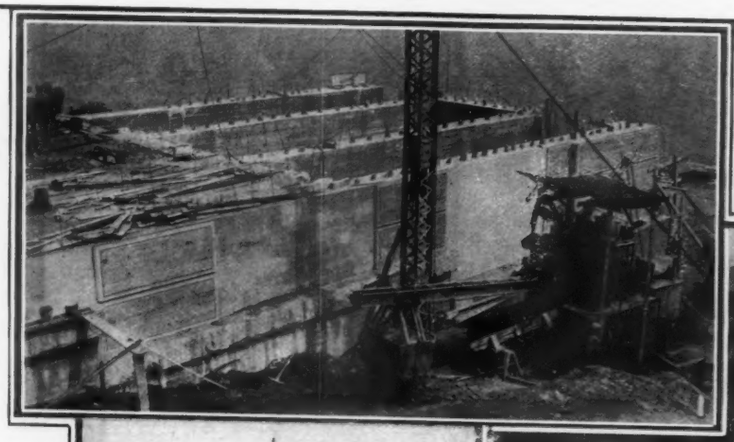
Before building operations could be started, indeed before some of the final structural details could be settled, it was essential that the engineers, Messrs. Robinson & Steinman, should know exactly what were the ground conditions at the points tentatively selected for the foundations for the main towers and the approach piers. In a general way, it was known that the geological formation beneath the waterway was composed of glacial drift made up of sand, clay, gravel, and boulders—with shale or granite underlying that deposit. It was essential that the piers should rest on stable hardpan; and the position of this could be ascertained only by making a series of borings. This exploratory work was done by Philip J. Healey, Inc., of New York City; and, all told, 17 cores were obtained with the Calyx drill. All the holes were carried down to bedrock—the deepest penetrating to a depth of 93 feet 6 inches below mean low water. Steel casings were driven down through the drift; and a casing could be forced through this stiff and compact material only after the core drill had been used ahead of it. This fact, in itself, satisfied the engineers that the piers did not need to be carried down to rock and that the foundations would be amply supported by the hardpan. The deepest excavation made for the foundation reached suitable hardpan at a level of 54 feet below the surface of Mount Hope Bay.

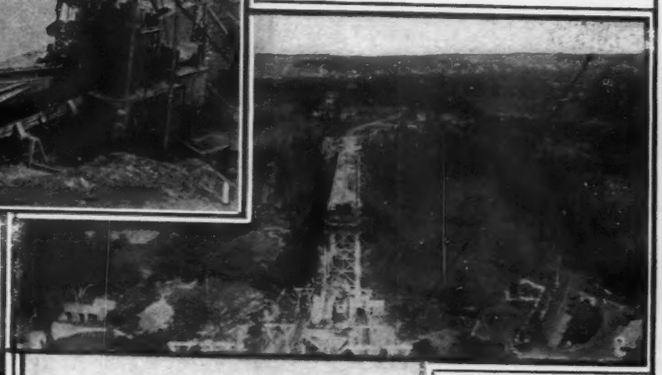
The central span of 1,200 feet is supported by two main towers, each 285 feet above mean low water. It was the foundation for the northern tower that was set at a maximum depth of 54 feet below the water line—the foundation for the southern tower resting on the hardpan at a depth of 38 feet below the surface of the bay. These foundations, which were constructed by The Foundation Company, New York City, were built within open timber cofferdams that were assembled on shore, launched, towed to their designed positions, and sunk after the sites had been dredged. The cofferdams, when located, were sealed at the lower edges with concrete; and this concrete, in bags, was placed by divers. The first or ground sections of the cofferdams did not reach to the surface of the water, and top structures were built on them and carried high enough above the bay to permit unwatering. With this work finished, the construction of the concrete foundations followed—the concrete being mixed on and delivered from a floating plant equipped with a tower 75 feet high.

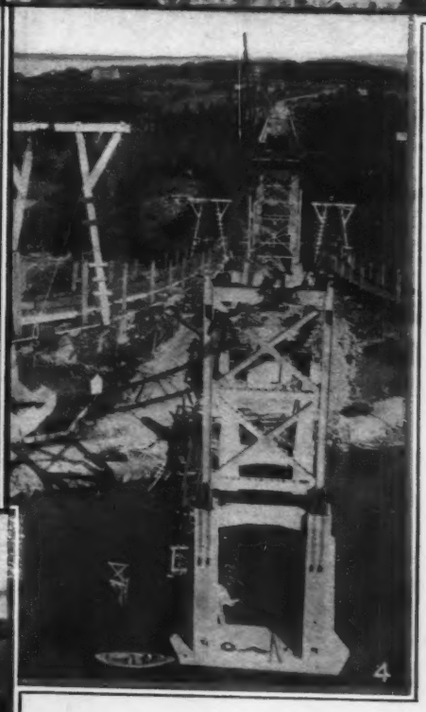
Each of the towers supporting the main span is of the fixed-base flexible type and has two cellular tower posts with lacing on the upstream and the downstream face. The cables, after passing over the tops of the main towers, pass over two cable-bent piers—forming the landward supports for the two 504-foot side spans, and then turn more abruptly downward toward a cable anchorage near each shore. At each anchorage the wire cables are secured to groups of steel eyebars which, in their turn, are attached to massive steel girders embedded in solid concrete in the anchorages. In excavating for the anchorage on the Bristol side of the bay it was necessary to remove considerable rock, and this work was done with "Jackhamers" furnished with air from two Type 20 portable compressors.

Compressed air from portables was used in the blacksmith shop and in the carpenter shop, and it was also utilized in driving un-

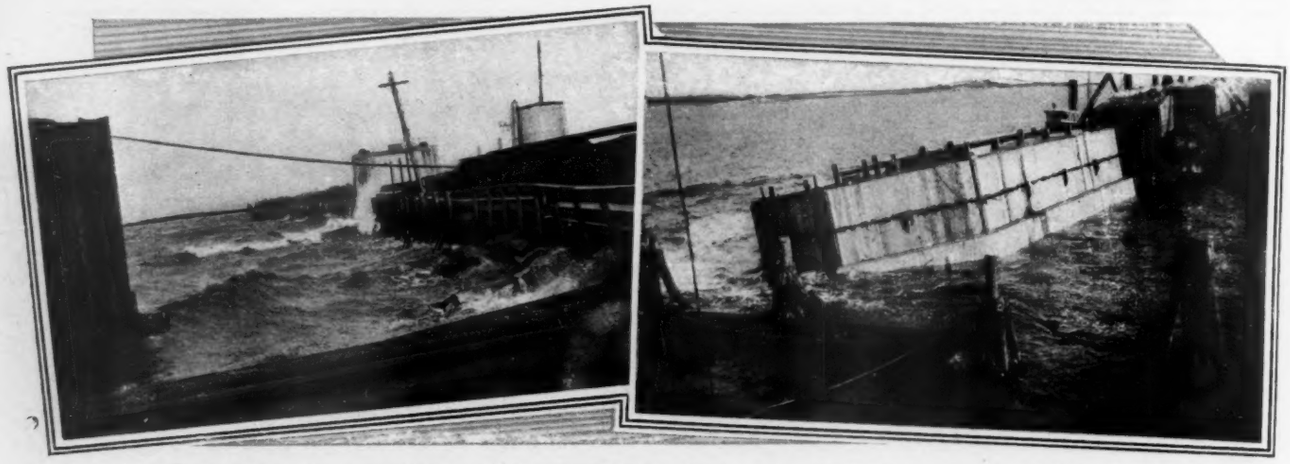
Left—"Jackhamers" did all the drilling in excavating the rock at the Bristol anchorage. Right—West Place, near one of the approaches to the Mount Hope Bridge.







1—Reinforced-concrete structure of the Bristol anchorage. 2—Bristol approach and Town of Bristol as seen from Pier 19. 3—Portsmouth anchorage under construction. 4—Cable-bent pier and Tower No. 20 at Bristol end of bridge. 5—Where rock was excavated for the Bristol anchorage, showing a portable compressor on far side of hole. 6—Rock spill adjacent to excavation for Bristol anchorage.



Left—Ferry slip as it appeared during stormy weather. Right—Launching caisson for Pier 18 of the bridge.

derwater piles, in operating pneumatic tools employed in constructing the caissons, in preparing bracing and timberwork at the Portsmouth anchorage, and in similarly getting bracing and forms ready for all the piers. Incidentally, it should be mentioned that The Foundation Company built the foundations for all the piers and towers resting below the water level.

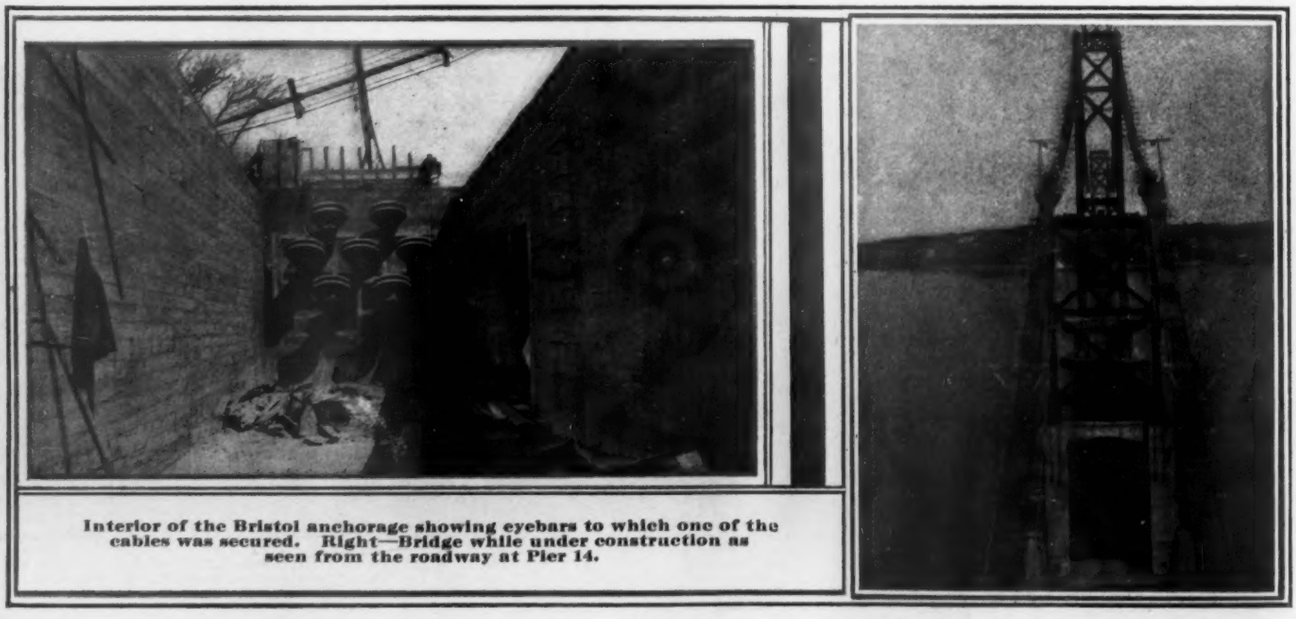
There are two main suspension cables, each of which is 11 inches in diameter and has a total cross-sectional area of 74 square inches. These are carried over the two main towers at points 34 feet apart. Each cable is composed of seven strands which, in turn, are made up of 350 separate wires apiece—making, all told, 2,450 wires per cable. Each of these galvanized wires is a shade less than 0.2 inch in diameter.

The floor of the bridge is hung from the main cables by suspenders, and each suspender is composed of four parts of 1⅜ inch steel-wire rope—two ropes being looped over each cable band. The suspenders are spaced longitudinally at intervals of 38 feet 4 inches. Most of the steel employed in the construction of the bridge is medium-carbon steel, but special steels have been used in certain parts of the structure to insure a maximum of strength in combination with a minimum of weight. In brief, every precaution has been taken to make certain that the bridge will come up to the highest engineering standards.

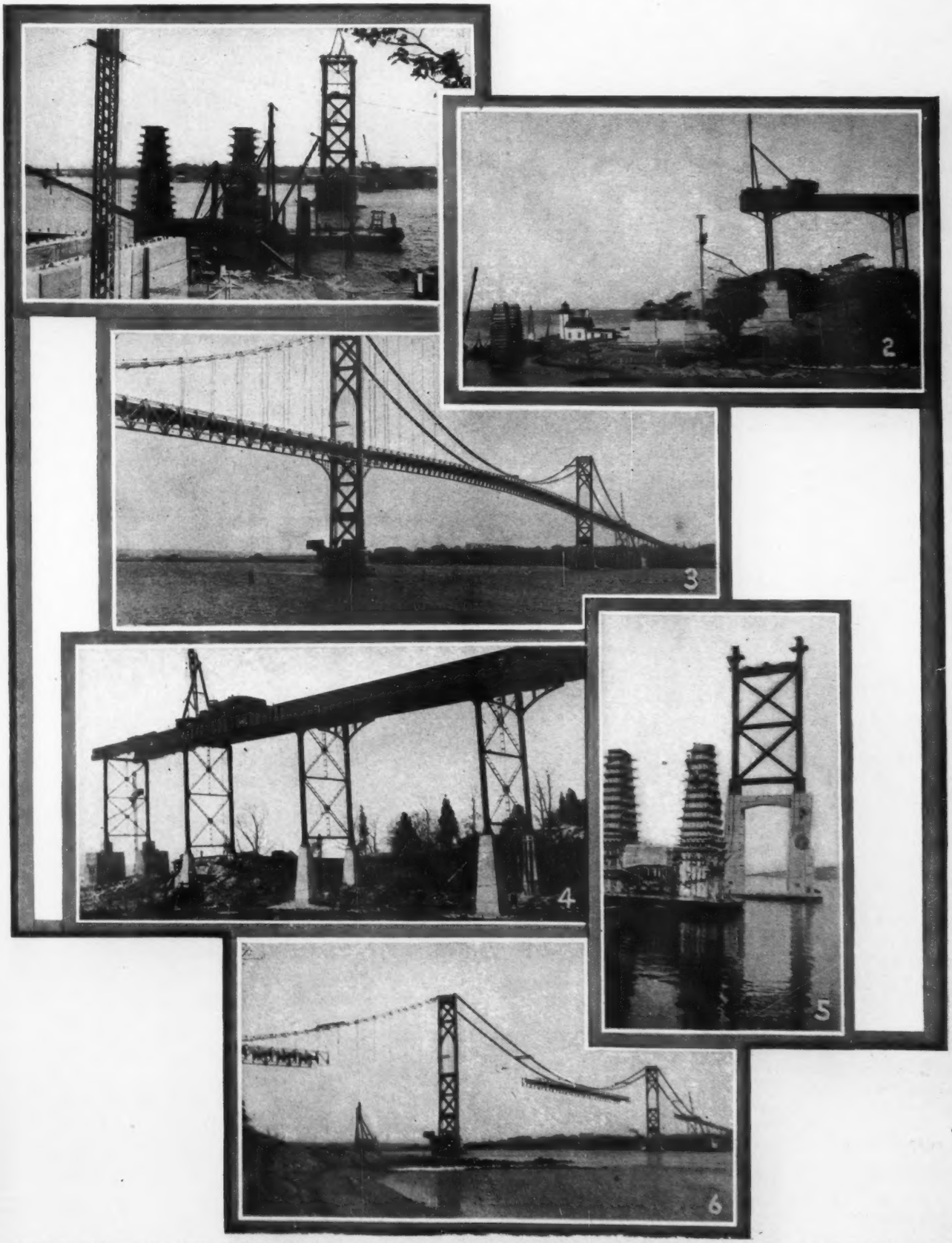
At the north end of the bridge—that is, the Bristol end, the approach is made up first of a concrete road 980 feet long that connects with a steel viaduct 1,096 feet long. This viaduct is supported on piers 100 feet apart longitudinally. The steel viaduct on the Portsmouth side of the bay is 1,706 feet long and is joined at the southern end by a concrete road that is only 130 feet long. The approaches to the steel viaducts have a 30-foot roadway, while the driveway between curbs on the main span and the viaducts is 27 feet wide. The roadway on the bridge is made up of 7-inch reinforced-concrete slabs resting on stringers that are supported, in their turn, by the underlying steel structure of the bridge.

In building the Mount Hope Bridge, steel girders 150 feet long were used in two of the viaduct spans—one on each side of the bay. These girders are said to be the longest ever fabricated, transported, and erected; and special facilities had to be constructed to handle them. The bridge will be capable of carrying, with an ample margin of safety, a live load of three lines of 20-ton trucks. All told, 40,000 cubic yards of concrete have been required; a matter of 8,350 tons of structural steel has been worked into the bridge; and there are 700 tons or 2,620 miles of wire in the main cables and the suspenders. The Bristol anchorage weighs 18,000 tons, and the Portsmouth anchorage weighs 27,000 tons. There is a clearance of 135 feet between the underside of the main span and the surface of the bay at high water.

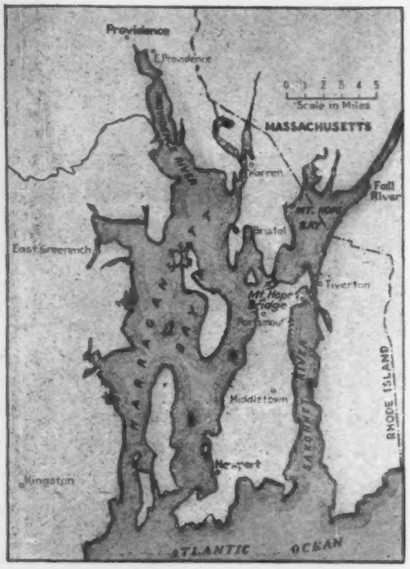
The Mount Hope Bridge is a fine example of engineering. Work on the foundations was started during the last month of 1927—the operations being carried on by The Foundation Company and the Callan Construction Company. The cable wire and steel suspender rope were furnished by the American Cable



Interior of the Bristol anchorage showing eyebars to which one of the cables was secured. Right—Bridge while under construction as seen from the roadway at Pier 14.



1—Scene of operations from the Bristol shore. 2—Pier 21 and anchorage on Bristol side of bay. 3—Mount Hope Bridge nearing completion. 4—Setting span No. 24. 5—Erecting steelwork of one of the main towers. 6—Showing manner in which the span was progressively projected while suspended from the main cables.



Map of region that will be served by the Mount Hope Bridge.

Company. The officers of the Mount Hope Bridge Company are: C. Philip Coleman, president; John W. Garrett II, vice-president; Herbert W. Smith, vice-president; George H. Newhall, treasurer; and William P. Sheffield, secretary.

Work on the bridge has gone forward in all departments at a decidedly rapid pace; and everyone concerned has given of his best to hasten completion.

KILO-MAN-HOUR TO MEASURE INDUSTRY'S EFFICIENCY

THE American Society of Mechanical Engineers has proposed a new unit of measure to indicate industrial efficiency—the kilo-man-hour, the labor of one man working 1,000 hours. In other words, the society recommends measuring output per man-hour instead of output per man, as is usually the case. It is reported that when all other factors in any business have been divided by the number of kilo-man-hours worked some surprising figures have been obtained. Thus it was found that the value of the output per kilo-man-hour varied greatly not only as between industries generally but also as between industries engaged in the same field of effort.

In manufacturing gas, for example, one company produced 40 times as much gas per kilo-man-hour as another. Again, in making gray-iron castings, the variation between companies was in the ratio of 16 to 1. In many instances, small concerns showed a higher physical output per kilo-man-hour than large companies in the same business. In fact, in as many as 35 different industries the smallest company of a kind had a higher production rate than the largest—in only eighteen was the condition reversed.

The construction of an underground railway in Seoul, the capital of Korea, is being planned by the Chosen Railway Company.

SPRAY-PAINTING OF STREET CARS SAVES MUCH

THE following extracts regarding the spray-painting of street cars and the ventilating of rooms especially built for the work are taken from the *Electric Railway Journal*, and describe what is being done in Germany by the Leipzig Street Railways.

The consolidation of two street railway companies, one with cars painted blue and the other red, necessitated the repainting of the equipment. To do this speedily and economically the spray method was used, since it was found that the brush method required more labor. When cars were entirely repainted after the removal of the old paint, the time per car with the spray method was 7½ hours as compared with 50½ hours, as follows:

Class of Work	Spray Hrs.	Brush Hrs.
Covering windows	½	..
First coat of oil paint	1¼	10
Two coats of zinc paint	2½	20
One coat of rubbing varnish	1¼	10½
One coat of lacquer	1	10
Removal of window covers	1	..
Total	7½	50½

To obviate the use of masks and to protect the workmen against noxious fumes, a special room with forced ventilation was built. This room is 53 feet long and 15 feet wide, and was erected in one section of the paint shop. Cars are run in and out through a door at one end; and in the opposite wall are four exhaust fans each with an opening of 27½ inches.

By means of a sprinkler system, water is sprayed in front of the fan openings. In its ascent, this water carries with it and deposits in a settling basin below the floor the particles of paint that would otherwise be drawn into the fans. After the paint in the settling basin has been separated from the water by gravity, the water is again pumped through the sprinkler system. The air exhausted from the room is purified for re-use. The compressed-air paint-spray outfits are suspended from overhead rails so that they can be shifted readily by the operators from point to point.

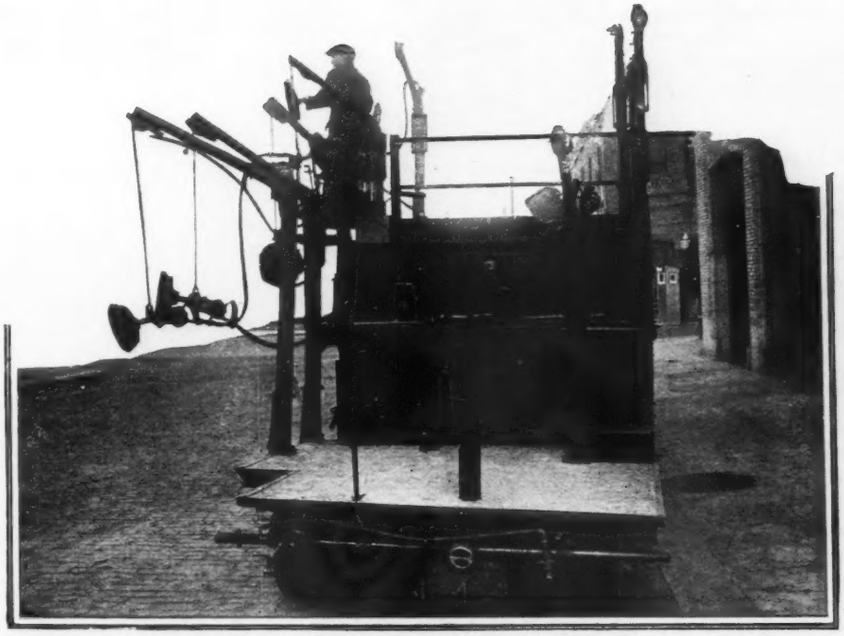
Some of the advantages claimed for the separate room and the equipment are: The exhaust fans do not become clogged with paint; there is no danger of spontaneous combustion; paint fumes are prevented from vitiating the surrounding atmosphere: the temperature of the chamber is easily kept constant; and dust, bits of metal, etc., from the rest of the shop are not drawn into the room because it has a ventilating system of its own. This is important in keeping slow-drying oil paints clean.

After thirteen years of work, the old Spanish Trail in the southern part of the United States has been transformed throughout the greater part of its length into a modern trunk highway that was dedicated to public service early in April of this year. Two-thirds of the road between St. Augustine and San Antonio has been completed, and the remainder is financed and in progress. Where there were 60 miles of ferries 26 months ago there are now only two, running day and night, in this splendid traffic artery extending across the continent from St. Augustine, Fla., to San Diego, Calif.

The Leaning Tower of Pisa stands on ground that is deficient in stability. Here we see an Ingersoll-Rand portable air compressor being used to force fluid cement into the foundation of the tower to prevent further settlement.

Air-Driven Rotary Brushes Keep Holland Tunnel Clean

SPOTLESSNESS is a conspicuous characteristic of the Holland Tunnel; and one may well wonder as he hastens through that subaqueous highway how this is achieved, especially as few if any of the general public ever see cleaners at work in the twin tubes. This is just one more evidence of the skill and the care exercised in maintaining the tunnel at its undeniably high degree of efficiency.



Close-up of the trailer showing manner in which the air-driven rotary brushes are suspended from the stanchions.

Anyone that has to do with a motor vehicle knows how hard it is to avoid soiled hands. The imperceptible soot from the engine exhaust settles here, there, and everywhere about a car, and it does this notwithstanding the fact that the vehicle is generally speeding away from its own exhaust and traveling in the open air. Through the twin tubes of the Holland Tunnel an average of 20,545 motor vehicles move east and west during a weekday, and Sunday and holiday traffic averages 36,391. Imagine, then, the volume of the exhausted gases and the chance for an appreciable percentage of the accompanying carbon to settle upon the tunnel walls despite the energetic action of the ventilating system. This soot would soon be visible but for the facilities devised and used to keep the tunnel clean. The nature of the task and the means employed to keep the tunnel spotless are described in the annual report of Mr. Ole Singstad, chief engineer of the New York State Bridge and Tunnel Commission. Let us quote:

"The routine work carried on by the department consists of the cleaning of approximately 345,000 square feet of tiled wall; 950,000 square feet of pavement in tunnels and plazas; 18,500 lineal feet of sidewalk; 16,700 lineal feet of hand rail; 6 buildings; 9 tunnel sumps; 12 toll booths; 2 plaza offices; cleaning and oiling 838 bronze doors; maintaining and cleaning 1,768 tunnel lights and 152 plaza lights, etc., etc.

"The principal routine task of the department is the cleaning of the tunnel, including walls, sidewalk, roadway, baffle plates, curb, bronze doors, etc. At the time of the last annual report it was stated that it took a gang of 30 men eight days to complete a cycle of cleaning. As the men became accustomed to the work, and as the organization was perfected, the number of men required to complete the cycle was reduced to about 20 and the time to five days.

"Early in the year (1928), cleaning of the tile, etc., was carried on throughout the entire day, but as the traffic increased it was found necessary to confine this work more and more to the light-traffic hours during the night. Even then, it was dangerous for the cleaners to work on the roadway, one accident occurring in which three men were injured, although not seriously. Subsequently studies were made to develop a mechanical tunnel-cleaning device to perform this work; and after the preparation of plans and the making of tests under actual working conditions, a contract was awarded to Howald, Klingelfuss & Kenny for furnishing such a device. It consists of a 2½-ton Mack truck on which is mounted an Ingersoll-Rand compressor, and of a trailer so constructed that it has platforms at various elevations supporting stanchions which carry the counterweighted rotary brushes used to clean the tiled walls.

"On this trailer is also mounted a 1,000-gallon tank divided into two parts, one containing a cleaning solution and the other the rinsing water. The brushes are driven, by compressed air, on a hollow spindle through which the cleaning solution is forced from the tank by air pressure. Six brushes are used in cleaning the tiled wall, baffle plates, and concrete ledge. An additional brush, automatically operated and controlled, cleans the top of the granite curb and the concrete behind the curb. There is a sprayer, attached behind the end of the trailer, connected to the clear-water section of the tank, and this is used to rinse the walls and baffle plates.

"This device has now been in service since early October and is operated by a crew of twelve men, including the foreman and the operator of the truck and compressor. It cleans one wall of one tunnel in the total

Motor truck carrying an Ingersoll-Rand portable compressor which furnishes the air to operate the pneumatic rotary brushes on the trailer and also supplies air to the tanks containing water and the cleaning solution.

elapsed time of about 6½ hours, which includes an hour for lunch and about half an hour used in refilling the tanks of the machine twice with water. This machine is used four mornings a week to clean the four walls of the tunnels. The lower half of the curved section of the tiled wall on the sidewalk side, on which the dust settles very rapidly, is given an additional cleaning by hand once a week. This work is performed by four men in two nights.

"From the foregoing it will be seen that the tunnel is kept in a much cleaner condition and at much less expense to the Commissions by the use of this mechanical device. With the hand method it took 100 man-days to complete the cycle. Under the present method it takes 56 man-days to clean the tile, a portion of it twice."

The air-driven tools that do the scrubbing are Ingersoll-Rand surfacers known as 6-G; and the trailer is equipped for eight of these. Each surfacer is fitted with a broad bristle brush, and through the hollow operating spindle is sprayed the cleaning solution—a hose connecting the surfacer with the tank on the trailer that carries the solution. The solution is delivered to the brush by compressed air acting upon the free surface of the fluid in the tank. By regulating the air supply it is entirely practicable to control the amount of cleaning solution fed to the brush. Similarly, the speed of the brush can be regulated by manipulating the valve in the operating air line.

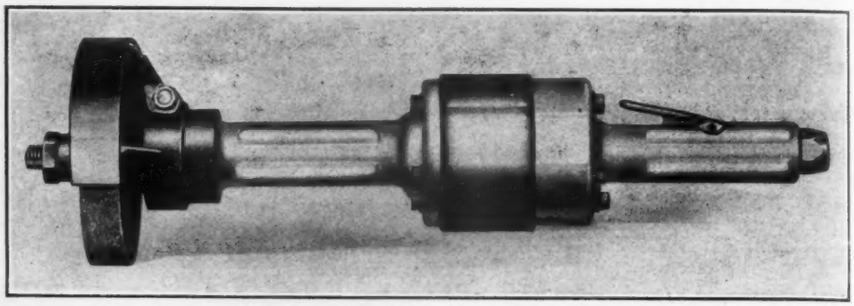
The water used for rinsing the walls after scrubbing is also subjected to air pressure; and by varying this pressure the force of the rinsing spray can be adjusted to meet conditions. The entire apparatus has functioned satisfactorily; and it represents just one more skillful application of compressed air in meeting a special situation that demanded an effective and an economical solution.

SMALL BLASTING MACHINE OF NEW TYPE

A NEW electric blasting machine that is so compact that it will fit into a coat pocket of average size has been announced by the Hercules Powder Company of Wilmington, Del. It weighs but 4¾ pounds; and it is the first machine of its kind and size designed in America to be built on the dynamo principle. This assures permanent capacity—an improvement over the old magneto type which lost power with age.

The new device, which is the outcome of three years of experimental work, is well suited for all manner of blasting where not more than ten shots are fired simultaneously. However, though it is rated to fire ten electric blasting caps connected in series, the small machine is said to possess a reserve of power of 100 per cent.

A so-called master wireless clock has been invented by a Russian radio expert. It is claimed that this clock will keep any number of specially adapted timepieces, including even watches, going and synchronized.



The new multi-vane grinder that is said to develop more power per pound of weight than do other rotary tools of this type.

NEW AIR-OPERATED GRINDER HAS MULTI-VANE MOTOR

A NEW portable pneumatic grinder, of a multi-vane type, has been developed by the Ingersoll-Rand Company of New York City. This machine was produced to meet the demand for a lighter-weight, smoother-running grinder, one capable of turning out more work while actually putting less strain on the operator. In fact, for its capacity, the multi-vane grinder is said to be the lightest tool of its kind ever offered for grinding work. It is made in two sizes, 3 and 3G, each of which weighs 12¼ pounds.

The 4-vane rotor, made of hardened and ground steel to reduce wear, is full-floating on its arbor, thus permitting it to align itself between the two end plates so as to prevent it from exerting harmful pressures against them. As the manufacturer has expressed it: The multi-vane motor is well balanced; and it combines the lugging power of the piston machine with the smoothness of running of the turbine.

To continue with the maker's description: By means of a governor, the grinder can be adjusted to make any desired number of revolutions up to 6,300 per minute. Therefore, grinding wheels of different diameters can be driven at their maximum or best cutting speed and, incidentally, kept from operating at a dangerous rate—speeds exceeding the maximum that may cause the wheels to burst. Standard machines are set to run at 4,200 revolutions per minute, at which speed 6-inch vitrified and 8-inch elastic bonded wheels operate at highest efficiency.

The wheel-end bearing consists of two radial thrust-ball bearings and takes the thrust from the grinding wheel. Lubrication of the tool is effected automatically. There is an oil chamber in the handle of the grinder, and from this chamber the oil is fed into the stream of live air admitted to the machine every time it is started. In this way all wearing parts are kept covered with a film of oil.

The grinder's exhaust deflector is so arranged that it also serves as a muffler. What is a "screech" in other rotary tools of this sort becomes a soft purr in the case of the multi-vane grinder because the air strikes against baffles before it is exhausted. The deflector, itself, may be turned to exhaust the air in any desired direction.

The new machine is suitable for a wide variety of work, such as grinding, buffing, polishing, and cleaning; and by fitting it with wire brushes it can be used with equal facility for removing scale, rust, paint, etc., from metal surfaces.

New pocket-size Hercules 10-cap blasting machine.

RECORD LOAD OF IRON

WHAT is said to be the heaviest wheel load on record is that carried by cars of a special type used by the Hamilton Coke & Iron Company for the transportation of railroad ladles filled with molten iron. Each car is 56 feet long, has 16 wheels, and weighs more than 340 tons when fully laden. They travel between blast furnaces at Hamilton and open-hearth furnaces at Middletown. Ohio, ten miles away The half-hour run is made over tracks and bridges of extra strong construction so as to bear the unusually heavy load. The iron shipped in this way will remain hot for 48 hours, thus obviating the need of reheating as would have to be done if it were delivered in the form of pigs.

Lights on top and around the outer walls of a huge gas tank, recently completed in East Toledo, Ohio, indicate a trend of the times. The structure, which is 284 feet high, is the tallest in the city, and the lights are put there as a warning to aviators flying over the municipality at night.

Producers of Pink Granite for Six Decades

John L. Goss Corporation's Quarry, On Crotch Island, Me., An Outstanding Example of Skillful Management

By R. G. SKERRETT

STONINGTON, at the southern end of Deer Isle, Me., is the business center of a granite industry that has flourished in that part of the state for a good many years. The numerous contributory quarries lie within what is known to the trade as the Deer Isle District; and the stone from these several sources is generally described as Deer Isle Granite. The beautiful product called Goss Pink Deer Isle Granite is obtained from Crotch Island, which is nearby to the south of Stonington. In fact, all the islands of this section of the coast of Maine are of a granitic formation, and bear mute evidence to the forces at work during the period of the last Ice Age.

During its slide seaward, the ice cap scored or ground away much of the underlying geological formation—only the most resistant of the rocky beds surviving that intense erosion. As the last of the glaciers launched themselves into the Atlantic, scattered islands appeared above the surface of the ocean where formerly there had been a far-flung expanse of mainland. These bald knobs of granite remained only because their rocky masses were able to endure the destructive action of the superposed and receding mountains of ice. Having withstood such a test, it is easy to understand why granite from that region has acquired a reputation for excellence in the service of man.

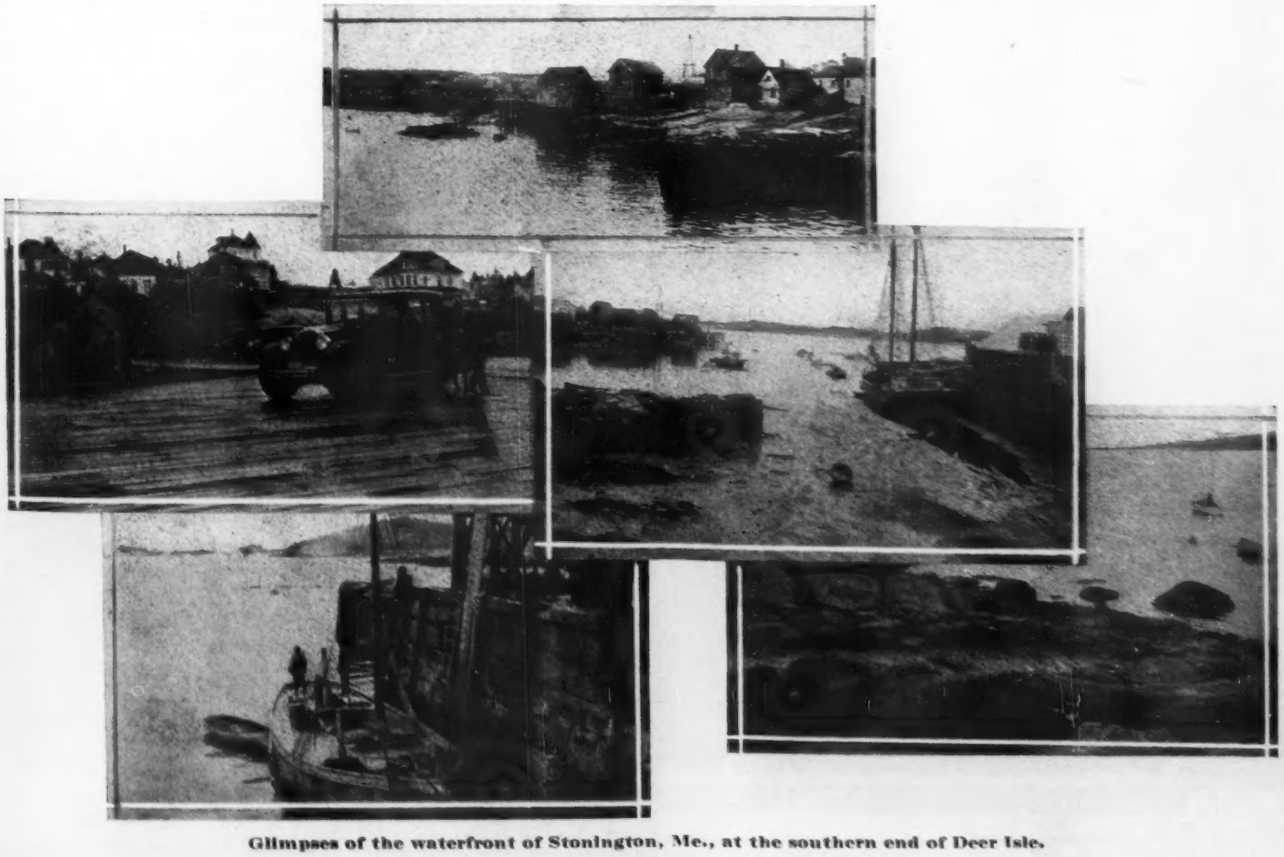
Not all the granites quarried in the Deer Isle District are alike in color, texture, and composition. They owe their different characteristics to the circumstances in which the molten magma was expelled surfaceward from the bowels of the earth and to the conditions surrounding the hot and plastic masses during their various periods of solidification. Goss Pink Deer Isle Granite has a warm and very pleasing tone, and has a compressive strength of 32,250 pounds per square inch, which is well above the requirements of all structural codes.

For the sake of those interested in such matters, we give the following authoritative chemical analysis of Goss granite:

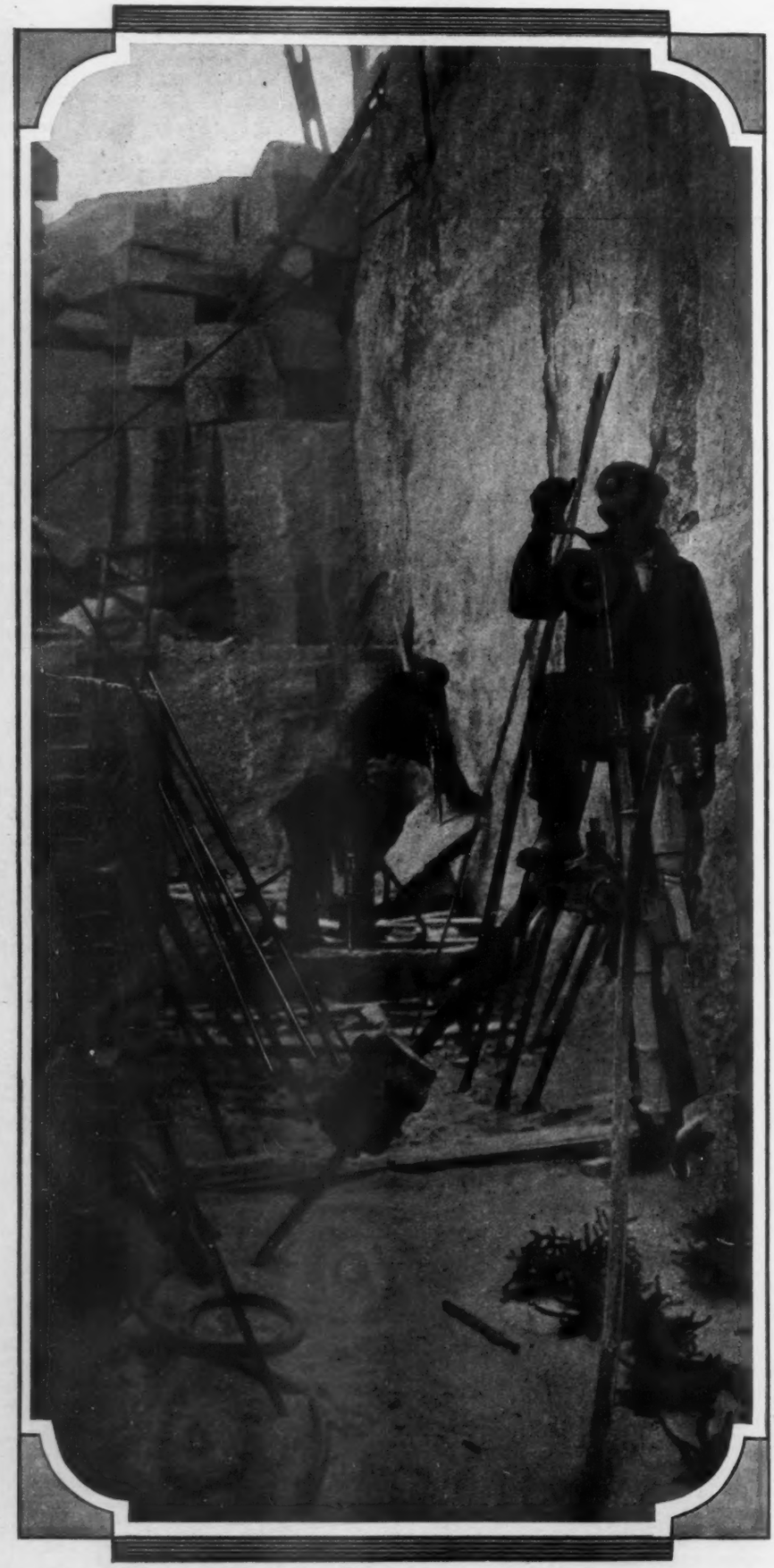
Moisture, loss at 221° F.	0.15	per cent
Loss on ignition	0.31	" "
Silica	73.33	" "
Alumina	13.58	" "
Ferrous oxide	0.72	" "
Ferric oxide	0.80	" "
Titanium oxide	0.20	" "
Calcium oxide	1.50	" "
Magnesium oxide	0.82	" "
Sodium oxide	3.88	" "
Potassium oxide	4.41	" "
Total sulphur calculated as sulphur trioxide	0.13	" "
	99.83	per cent

Apparent specific gravity, 2.638

Job G. Goss, the pioneer of the granite industry of Stonington, opened a quarry on Crotch Island 60-odd years ago; and John L. Goss, president and organizer of the present corporation, assumed the leadership of the business in 1888. The quarry has always been located at the southeastern part of Crotch



Glimpses of the waterfront of Stonington, Me., at the southern end of Deer Isle.



An X-70 drilling deep holes in channeling work at one end of a long strip of granite. Livingston plug drills are being used in block-holing pieces of granite.

Island where the geological formation is a great granite dome that rises to a maximum height of 128 feet above the sea.

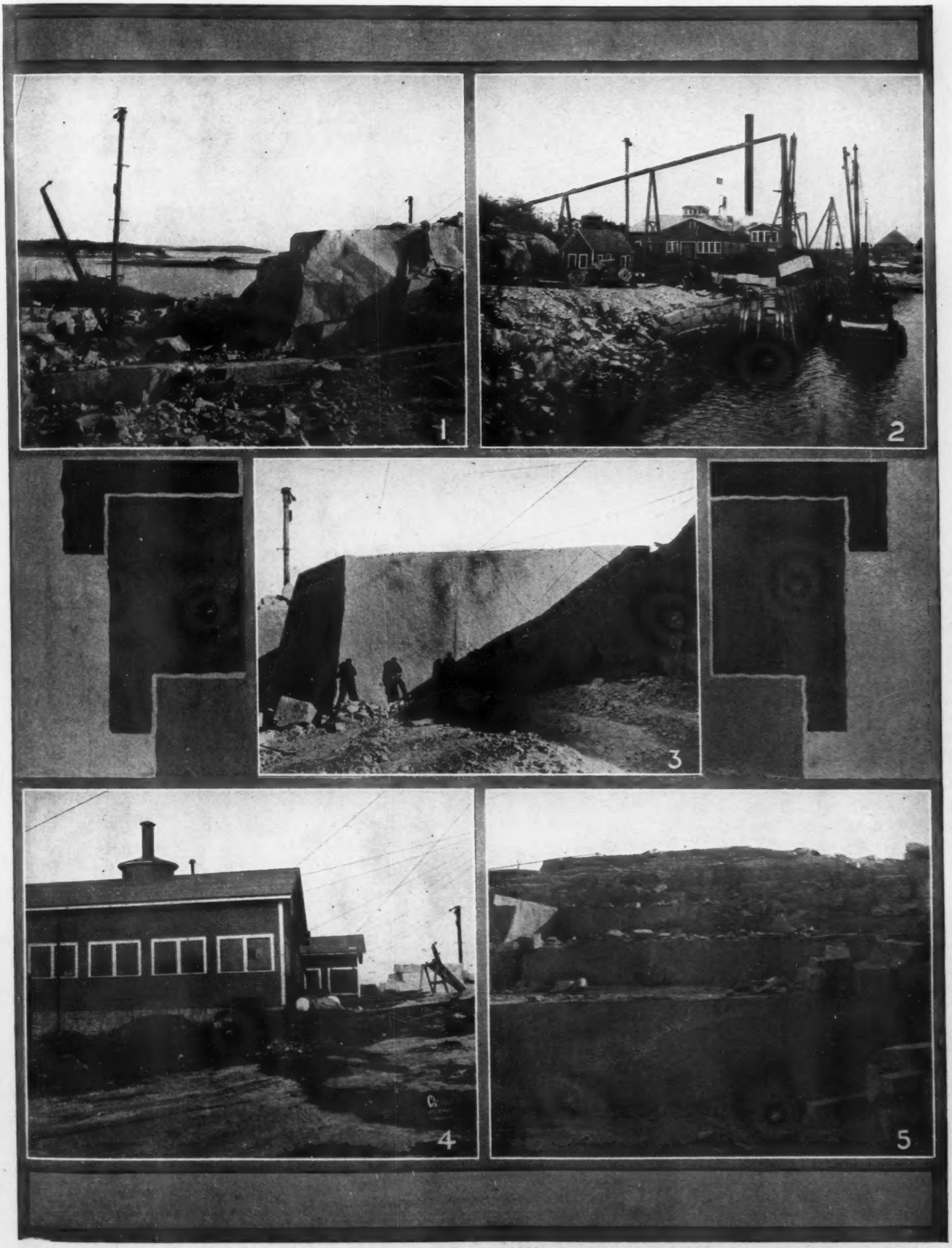
Job G. Goss carried on his quarrying operations in a comparatively modest way; and even after the organizing of the John L. Goss Corporation the company's holdings were far from extensive—three competing concerns occupying much of the property now controlled by the corporation. We can therefore understand what Job G. Goss meant when he said to William McKenzie, general superintendent for the corporation, 30 years ago: "Bill, quarrying on Crotch Island is pretty nearly finished". At that time the Goss quarry was little more than a niche in the granite dome. This fact is interesting because it helps us to grasp what has been done in the meanwhile in developing the property to its present splendid scale.

Speaking of William McKenzie, the corporation has publicly stated: "To his mechanical genius and unremitting thoughtful effort we owe the perfection of the quarry methods and much of the equipment." If a hole in the ground can appropriately be described as a monument to a man's skill and resourcefulness, then as such we may speak of the great quarry that produces the famous Goss Pink Deer Isle Granite. In the course of his decades of service, William McKenzie has so expanded the niche he first knew that the opening now has a north-and-south length of 1,000 feet, an east-and-west breadth of 500 feet, and a depth of 100 feet. In the course of a year the quarry produces an average of 50,000 tons of salable stone!

To most of us, a deposit of granite is an inert mass that constitutes a dead record of stupendous forces that expended themselves ages and ages ago. To William McKenzie, the quarry on Crotch Island is, to a large degree, a vital thing surcharged with pent-up energies that must be taken into account and carefully directed in order that the granite can be freed from the primordial ledge with a minimum of loss in the process.

As he picturesquely expresses it: "That stone was put there to stay: locked in and buttressed so that it would not budge. How well Nature did her job we know because the stone remained undisturbed when the retreating ice cap lay upon it and gradually ground its path to the sea. When we set about detaching a great block of granite from that mass we know that we must give the stone, which is under tension, a chance to relax much like a released spring; and if we don't take care in directing this readjustment, the granite will split and break destructively so that only a little of it will have any commercial value."

William McKenzie's insight seems at times almost uncanny; and whatever may be the source of his exceptional understanding of that granite dome, there is no denying that this knowledge has played and is playing a conspicuous part in the success of the corporation. Again, his inventiveness has produced equipment singularly suited to meet conditions in and about the quarry. In running blocks from the quarry to the cutting



1—Eastern end of the quarry on Crotch Island and one of the large derricks that facilitate the handling of the stone. 2—A steel lighter, at the quarry dock, being loaded with blocks of granite. 3—This block of granite, just detached from the main body of the ledge, is about 50 feet long and 20x22 feet in cross section—a mass of 2,000 tons. 4—The thoroughly up-to-date blacksmith shop where all the drill steels are conditioned. 5—The southwestern corner of the quarry showing plainly the varying depths of the sheeting planes or beds.

These two XPVR compressors are capable of providing 3,023 cubic feet of air per minute for various operating purposes in and about the quarry.

sheds or to the dock for shipment, the cars used have double-flanged wheels, and because of this provision they never leave the track. An ingenious system of interrelated cableways does the hauling; and gravity is utilized wherever practicable. The cars automatically pick up or drop the cables at certain points, and the shift is effected by amazingly simple apparatus—also of Mr. McKenzie's devising. He knows all the details of every bit of equipment on the property; and it is this complete grasp of the facilities at his disposal, combined with rare resourcefulness, that enables him to meet any emergency promptly and effectually. In many ways William McKenzie is exceptional; and just as he has developed the quarry of the John L. Goss Corporation so has he developed himself in the three decades that he has worked there. He tells with justified pride—pointing to a sizable daily output of well-written letters—that he could not sign his own name when he first took his job on Crotch Island!

The methods employed in getting out the granite have been evolved by Mr. McKenzie to meet the physical conditions prevailing at the quarry. The granite lies in beds or horizontal "sheets" that increase in thickness from the crest of the dome downward; and they vary from 12 to 30 feet through. Advantage is taken of the natural disposition of the granite in quarrying it; and the aim is to maintain a long, straight vertical face at right angles to the "rift" or plane of easiest cleavage. Inasmuch as the face of the quarry is now about 400 feet across, it has the appearance of a magnificent stairway fashioned for the tread of Titans.

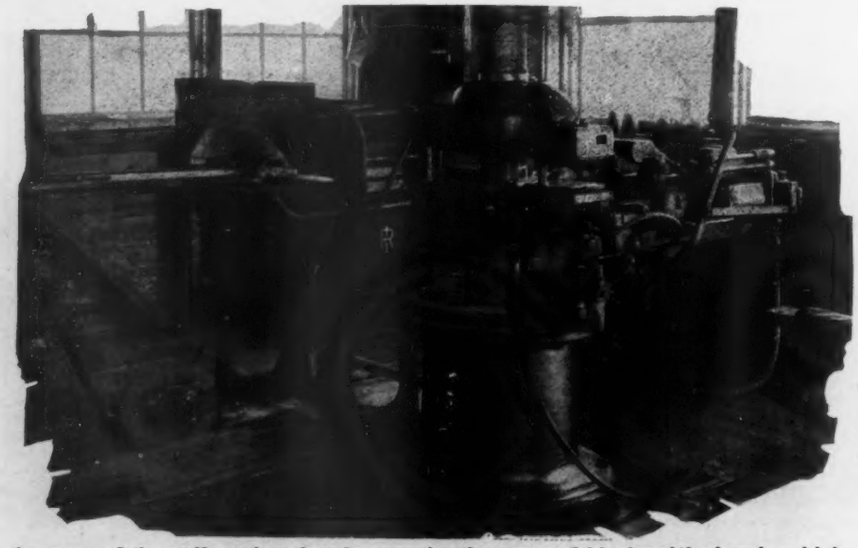
In getting out the granite, the first step is to free a great monolithic strip as long as the quarry face and as deep as the particular sheet upon which the quarrymen are working. Such a strip may be nearly 400 feet in length, 40 feet in width, and 20 feet in height—representing a mass of 23,500 tons. The strip is detached from the ledge by groups of lewis holes, suitably placed back from the face of the quarry, and by releasing the ends of the strip by channels made at right angles to the face of the quarry. The lewis holes, in groups of two or five, are drilled nearly through the vertical thickness of the sheet of granite, and each of these group is aligned in the plane of the desired split. The first group of lewis holes is driven approximately at the rear of the center of gravity of the strip; and the holes are charged with the contents of a keg of black powder. When the powder is fired, the blast starts a split in each direction longitudinally from the lewis holes; and, depending upon conditions in the stone, the split may extend for from 50 to 300 feet. If the bed be open the split will be longer; and the split will be shorter if there are any obstructions to the free movement of the mass. Any residual or initial strains in the rock will affect the action of the blast.

The quarrymen trace carefully the line of fracture made by the first blast, and at the end of that seam—possibly at each end—they drill another group of lewis holes. The firing of this group extends the split; and from one to four such groups may be required in carrying the seam from end to end of the strip. In channeling the ends, by which the strip is entirely freed from the ledge, dynamite instead of black powder is employed for blasting.

Each channel is 18 inches wide, and the holes on one side of the channel are staggered in relation to the holes on the opposite side of the channel. All these holes are drilled to the bed or sheeting plane with an X-70 drill—the holes in each line being spaced at intervals of 16 inches. The stone between the two parallel lines of holes is blasted out with high-powered dynamite—the quickest-acting obtainable. In doing this a chamber is formed successively at the bottom of each hole—working backward from the hole nearest the face of the quarry.

The chambering is done with four sticks of explosive. After the first and the second holes are chambered, a single cartridge, suspended by a wire, is hung in the first hole a short way above the chamber, and after this has blown out the rock between it and the face a similar procedure is followed in the case of the first staggered hole in the opposite line. This method is continued rearward and upward—the idea being to furnish a vertically widening outlet for the blasted rock and at the same time to direct the explosive force toward he face so as not to split the rock forming the flanking walls of the channel. The uppermost course or bridge is the last of the rock removed. With the channels finished, then another charge in the lewis holes is fired and the strip, as a whole, is freed from the ledge.

The sequence of "lewising" and channeling



A corner of the well-equipped and conveniently arranged blacksmith shop in which are installed a number of Leyner sharpeners and Ingersoll-Rand oil furnaces.

1—Some of the big derricks at the west side of the quarry. 2—Plug-drilling a sizable piece of granite. 3—Looking eastward into the quarry. 4—William McKenzie, general superintendent. 5—The water-filled pit, at the northern end of the quarry, from which the steam plant obtains its water supply. 6—"Jackhamers" drilling knox holes in getting out large blocks from a great strip of granite. 7—A massive block being split up into smaller pieces—"Jackhamers" doing the drilling. 8—Splitting a piece of granite with plugs and feathers.

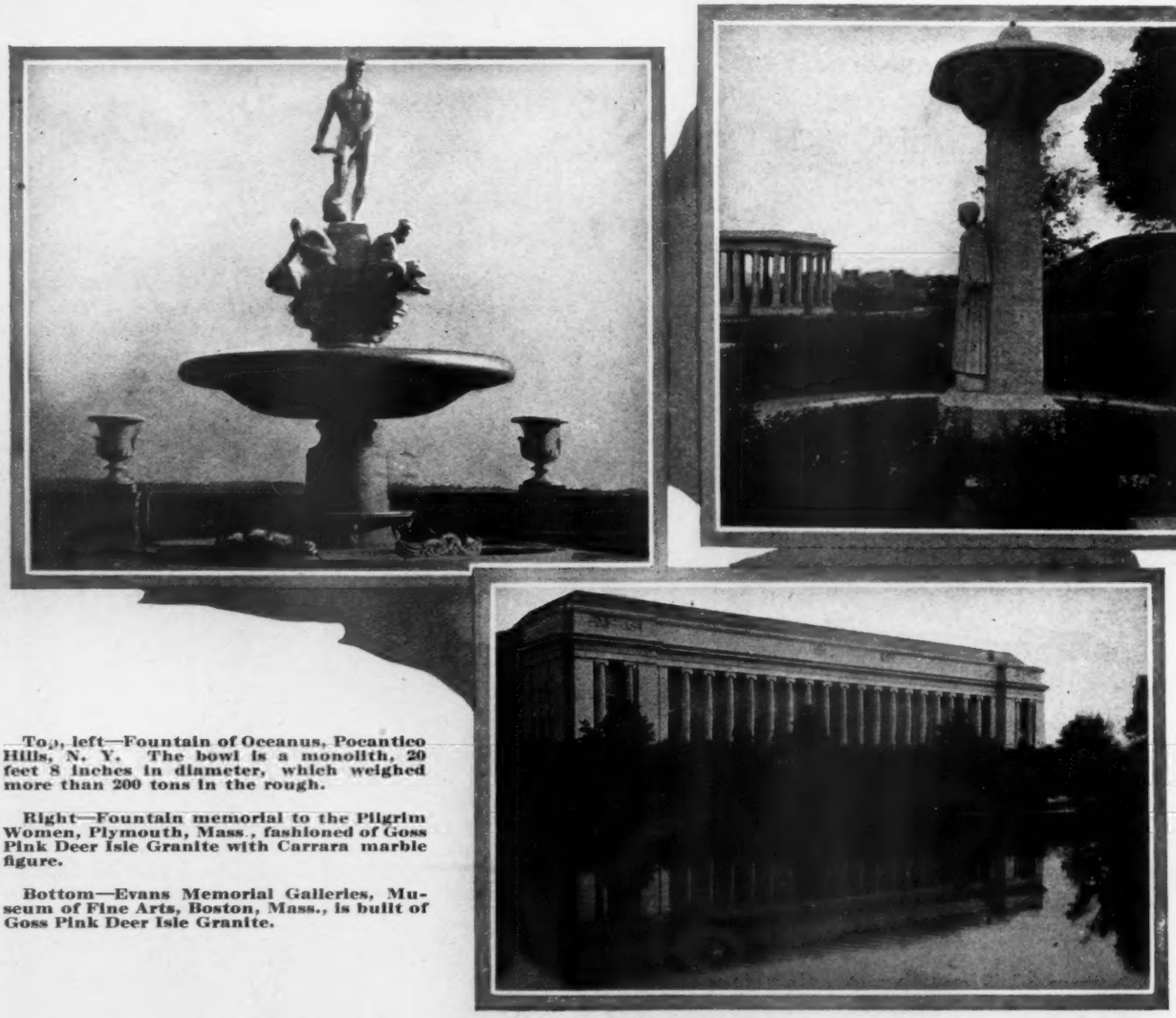
depends upon the condition of the strain in the sheet as well as the direction in which that strain is exerted. Under some circumstances, the channeling is left undone until the lewising is substantially completed. It is impossible to drive the lewis seam quite up to the bulkhead until the end is freed. Under other conditions, the channeling may be done first, as this tends to keep the lewis break back from the face. As the quarry is now being worked, the channel is usually blown out partway before lewising is started. Next the channel is completed; and finally a concluding shot is fired in the lewis hole nearest the channel. A skillful quarryman can guide his lewis splits along the desired line by governing their relation to the channel and by a nice control of the amount of powder in each charge.

After a strip has been freed in the manner described it is cut up into large blocks by drilling lines of plug holes which are supplemented by knox holes drilled with "Jackhamers". The depth of the knox holes depends upon the vertical thickness of the strip; but under present conditions in the quarry they run from 2 feet to 2 feet 6 inches. A line of wedges and half-rounds is set up in the plug holes; and while the wedges are exerting a strain the knox holes are fired with a succession of very light charges. Between each firing the wedges are again driven tight. This procedure continues until the stone splits all the way down to the bed.

Some of these blocks are of impressive dimensions—and may measure 50 feet in each direction. They are generally moved outward a few inches by the shove of a charge of powder fired in the seam at the rear. This operation insures the block being entirely free from the ledge. These great masses of granite are further subdivided, by a duplication of the process just described, until the blocks are so reduced in size that they can be split easily with plug wedges alone.

In splitting up the strip the object is to get out blocks of commercial sizes that can be handled by the derricks and the cableways with which the quarry is amply provided—the blocks being moved in this manner to the storage yard or sheds or to cars that convey them to the shipping dock. Being at tidewater gives the quarry an advantage in transporting its product at low cost to Rockland, Me., or to other seaboard railway terminals. The largest single block picked up by the biggest derrick on the property weighed 110 tons. The largest single block produced and finished as a monolith weighed 225 tons and, in the rough, measured 22x22x5¼ feet. From this block was cut the basin for the Fountain of Oceanus, erected by John D. Rockefeller on his estate at Pocantico Hills, N. Y. This block was moved 700 feet on rollers in twelve days; and during the cutting of the basin on Crotch Island it was necessary to turn over this ponderous and awkward mass. This was mastered with relatively ridiculous ease by Mr. McKenzie, who had a pit dug with sloping sides. When the stone slid gently down one side of the V it was not a difficult matter to pull it into a vertical position and then to let it come gradually to rest on the opposite side of the V. It was moved from the trench and carried back reversed to the cutting shed for completion.

Because of the care exercised in getting out the granite, the Goss quarry is noted for producing "good patterns"—that is, sizes and shapes with a minimum of waste material to be removed by the stonecutter and, therefore,



Top, left—Fountain of Oceanus, Pocantico Hills, N. Y. The bowl is a monolith, 20 feet 8 inches in diameter, which weighed more than 200 tons in the rough.

Right—Fountain memorial to the Pilgrim Women, Plymouth, Mass., fashioned of Goss Pink Deer Isle Granite with Carrara marble figure.

Bottom—Evans Memorial Galleries, Museum of Fine Arts, Boston, Mass., is built of Goss Pink Deer Isle Granite.

entailing a moderate expenditure of labor in finishing them for setting. This is in part due to the fact that Goss Pink Deer Isle Granite splits very close to true on the cleavage planes. The stone is what s technically known as biotite granite; and when it is polished each crystal is sharply defined and its color brought out vividly. The stone is what might be termed a "general-purpose" granite; and this is confirmed by the wide and varied uses to which it is put.

Compressed air is extensively employed at and in the Goss quarry; and mo:t of this operating air is furnished by two large XPVR compressors which have a combined output of 3,023 cubic feet of free air per minute. This air is piped from the power house to every part of the property where it can be utilized; and in addition to the three receivers at the compressor house there are five receivers interposed in the line to take care of condensation. Every receiver is drained nightly through a bottom valve.

The hoists operating the various derricks, while designed for steam drive, are usually run on compressed air that goes through the boilers so that the same lines from the boilers can be used when the latter are fired. Air-operated hoists are sometimes placed on the decks of the vessels at the dock to facilitate loading. All the drills in the quarry are driven with air; and the blacksmith shop is equipped with a number of Leyner sharpeners and several oil furnaces—all of them utilizing compressed air. The shop is also provided with air-driven grinders; and a 612-pound steam hammer, used for drawing steels, is operated with compressed air.

The working force employed on the island by the John L. Goss Corporation numbers 65 men; and all of them live in Stonington—the company providing a housed motorboat large enough to move the men to and from the quarry. Most of them have been identified for years with activities there, and they show many evidences of a community of interest. The officers of the corporation are John L. Goss, president; Fred A. Torrey, treasurer and local manager; William McKenzie, general superintendent; and M. L. Button, assistant treasurer and auditor.

NEW TRANSATLANTIC CABLE OF HIGH CAPACITY

THE new transatlantic cable recently opened to public service by the Western Union Telegraph Company is said to offer the fastest means of communication of the kind anywhere in the world. The cable, which was laid at an outlay of approximately $2,000,000, has a length of 1,341 nautical miles, and connects Newfoundland with the Azores. It serves as an additional and important link between America and Germany, Spain, Italy, and Africa, providing direct communication between New York and those countries by means of automatic relays at Newfoundland and the Azores.

Aside from its commercial significance, it represents a departure in cable construction because of the use of certain principles of electrical engineering that permit it to be operated simultaneously in either direction at full capacity. No fewer than eight separate messages—four incoming and four outgoing—may be transmitted over the cable at the same time. This has been made possible largely by a new alloy of nickel, cobalt, and iron, called mumetal, which is used both in the form of a wire for wrapping and in the manufacture of the core.

The modern submarine cable is an intricate piece of work, as the following facts will disclose. In this particular case the two ends, extending about 160 miles from each shore, have a core consisting of 500 pounds of copper and 300 pounds of gutta-percha per nautical mile. The next adjoining sections, each approximately 70 miles long, have a core made up of 325 pounds of copper, 50 pounds of mumetal, and 270 pounds of gutta-percha per nautical mile, while that of the main deep-sea section contains 280 pounds of copper, 60 pounds of mumetal, and 225 pounds of gutta-percha for every mile. This central section of the conductor is covered throughout its entire length with five spirally wound copper strips around which is closely wrapped fine wire of mumetal. It is interesting to note that this newest of transatlantic cables, when operating to capacity, does the same amount of work performed by several of the older ones.

AIR REGULATOR FOR ROTARY WIRE BRUSH

A NEW wrinkle that is designed to keep operators of air-driven wire brushes on their feet has come from the shops of the Pittsburgh Railway. In cleaning the steelwork of bridges or other lofty structures with these machines, the men must work from scaffolding or other positions that offer none too sure a footing at the best; and it was found that the torque exerted by the rotary brush, when given the maximum pressure, was sufficient to throw a man not on guard off his balance. A valve regulator in the form of a setscrew prevents this.

The regulator consists of a ¼x3-inch stove bolt that is mounted in the top of the handle. It can be set as desired, thus limiting the amount of air admitted by the trigger valve. This simple arrangement enables the operator to maintain a strong grip on the machine and to do effective work with comparative safety.

COMBUSTIBLE-GAS DETECTOR SAFEGUARDS WORKERS

A PORTABLE instrument that detects immediately the presence of combustible gases or vapors and records whether or not the atmosphere containing them is safe to breathe or safe when in contact with a spark or flame, has been placed on the market by the Union Carbide Sales Company. The device is a modification of the fire-damp or methane detector for coal mines developed in the laboratories of the Union Carbide Company and previously described in these pages.

As both instruments are essentially alike in construction, it will suffice to say that the new indicator, which has a much broader field of service, makes use of the effect of combustion of mixtures of inflammable gas and air on the surface of a heated filament—the combustion raising the temperature of the filament and, consequently, its electrical resistance. This change in resistance causes the needle of a meter to move over a scale, thus giving the desired information as to the condition of the atmosphere. The scale is of a kind that renders the instrument equally useful to the average workman, chemist, and safety engineer.

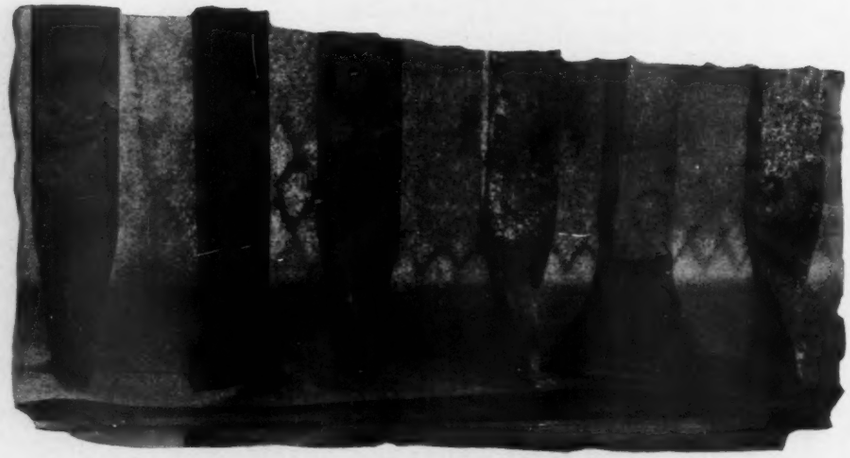
With the exception of gas-air mixtures containing acetylene or hydrogen, the apparatus can be counted upon, it is claimed, to indicate with precision the hazards lurking in a wide range of explosive mixtures.

Lowering the detector into the hold of an oil tanker to determine whether or not it is safe for men to enter it.

Modern Centralized Blacksmith Shop

By FRED J. URSEM

IN opening up a quarry, mine, or kindred property, one of the first things to be attended to is the building of a blacksmith shop. This shop is generally constructed and equipped hurriedly—any sort of a structure being good enough for just a blacksmith shop. Most of us have seen them, and so we know. If the property is a paying one and the organization grows, then more blacksmith shops are needed and, not infrequently, these are no better either in construction or arrangement than the first. In brief, blacksmith shops and their facilities, aside from the anvil and the forge, are more often than otherwise inadequate and, therefore, costly.



Contrast the three handmade bits on the left with the three on the right which were reconditioned on the pneumatic sharpener in the centralized blacksmith shop.

If the blacksmith, as is often expected of him, makes some of the tools of his trade—such as hammers and tongs—he goes about it in most cases by hand-forging. This may involve considerable waste of fuel and material because of overheated steel and steel not properly hardened. But, apart from that, a poorly laid out and equipped blacksmith shop cuts down plant output and for that reason should not be considered, as it has in the past, an unproductive part of a quarry or mine, whatever it may happen to be.

For more than half a century of continuous working, the Amherst, Ohio, quarry of the Cleveland Stone Company, whose general offices are located in Cleveland, has erected and used blacksmith shops of the type described. As production increased, shop after shop was built, all equally inefficient, until there were ten of them on the property. Not until the management set about trying to effect operating economies and to find better ways of doing things was it revealed how wasteful in time, labor, and material these ten widely scattered blacksmith shops were, and to how great an extent they tended to slow up production.

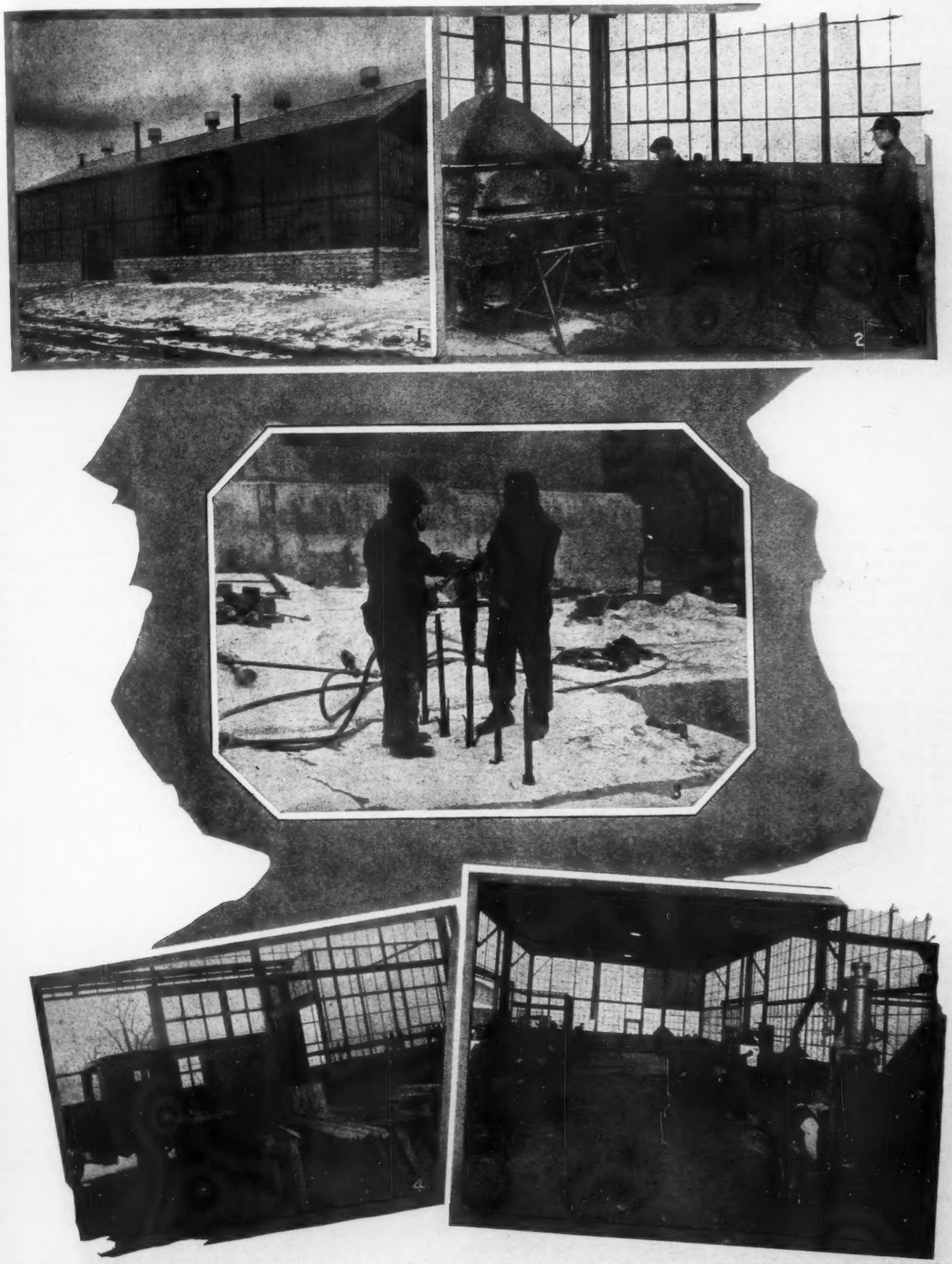
It was then that the idea of a centralized blacksmith shop was conceived and executed after careful study and calculations had proved the scheme to be entirely feasible. In place of the numerous antiquated structures there now stands at a strategic point on the property the thoroughly modern building shown in one of the accompanying illustrations. It is 90 feet long and 40 feet wide, and its steel-frame-and-glass construction assures plenty of light within. It rests on a foundation of "gray canyon" sandstone, which was quarried, cut, and sawed on the premises, and has a fireproof roof. The five ventilators in the roof are supplemented by side ventilation, thus at all times assuring a free movement of air and making for excellent working conditions in the shop. The result has been a marked increase in efficiency on the part of the blacksmith force.

Left to right—M. H. Owens, master mechanic of the Cleveland Stone Company; Paul A. Mori, general superintendent; and Jacob Kolb, blacksmith-shop foreman.

Before construction was begun a great deal of thought was given to the general layout of the plant, and everything has been done to make it as convenient and complete as possible. There is a locker room for the men, an office for the foreman, and a stock room for bar steel. In addition to a drop hammer and anvils, the shop is provided with the latest type of pyrometer-controlled oil forge and with an Ingersoll-Rand No. 50 sharpener. This machine is fitted with special equipment that enables it, besides sharpening drill bits and making shanks, to turn out 3-bit—two straight and one diagonal—gang channeler bits. With the old handmade bits there was always the trouble caused by steels "hanging up" in the cuts. By the new method this difficulty has been done away with almost entirely. As a consequence, channelers are cutting more rapidly and uniformly. That is just one of the reasons why the pneumatic sharpener is now considered indispensable. While no accurate figures are available, it is a known fact that the machine—that is, the use of better bits—has lowered the cost of operating the channelers because they are not as frequently out for repairs as they used to be in the days of the old blacksmith shops.

There has also been noticed an appreciable saving in steel due to fewer broken bits and less burned steel. Coal fires are a fruitful source of burned steel, and when this occurs it is necessary to cut any where from 6 to 8 inches from the overheated piece. This is now prevented by the utilization of a No. 25 Ingersoll-Rand oil furnace which, furthermore, does much other forging work about the shop.

The work is delivered to and from this centralized blacksmith shop by truck, so that there is no standing around in and about the shop by men from different sections of the quarry wasting time waiting for their particular lots of sharpened steels. The shop fore-



1—The centralized blacksmith shop at the Amherst quarry of the Cleveland Stone Company. The work now performed in this fine structure used to be done far less effectively in ten old-fashioned buildings scattered about the premises. 2—The section of the shop devoted to drill-steel sharpening is equipped with a No. 50 sharpener and a No. 25 oil furnace 3—Since the new blacksmith shop has been in operation, fewer drill steels are broken in service. 4—The accessible bar-steel stock room. 5—General arrangement of the well-lighted, thoroughly modern blacksmith shop which has effected marked operating economies and increased the quarry's output.

man sees to it that the work is out on schedule; and it is his duty to superintend the heating of the steel and to attend to its hardening.

Under present conditions, the results obtained have been very gratifying—they speak for themselves. To be brief, the up-to-date centralized blacksmith shop, compared with the ten really primitive units that it has supplanted, has made it possible to cut down the use of fuel by approximately 5 per cent and that of steel by 10 per cent; it has speeded up production generally about 10 per cent; and it has reduced the working force by four men.

The writer wishes to express his indebtedness to M. H. Owens, master mechanic of the Cleveland Stone Company, and to Paul A. Mori, general superintendent, for the information contained in this article. Mr. Owens, it should be stated, fathered the idea that led to the erection of the centralized blacksmith shop at the Amherst quarry of the Cleveland Stone Company.

SIMPLIFYING AIR-LIFT CALCULATIONS

By J. H. Pound*

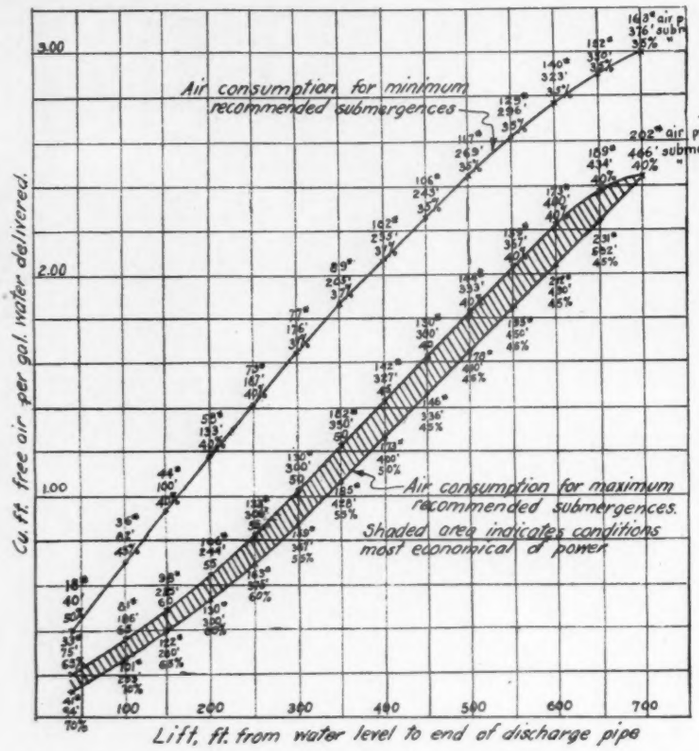
THE accompanying curve sheet presents some data on pumping water by the air lift and is in a form which the writer has found very useful. The data itself is not new, being taken from an Ingersoll-Rand bulletin. The writer realizes that such data can be presented in several other ways, but this arrangement has the advantage of showing on one sheet and on one set of axes all the data usually needed in determining the compressor capacity required by a given well. With this sheet at hand, no logarithmic tables and very few calculations are needed in determining, for a given lift in feet, the air consumption in cubic feet per gallon of water, the maximum and the minimum recommended submergence in feet—hence the required depth of well, and the most economical submergence range recommended.

For example, suppose the water level in a well is expected to stand during pumping 430 feet below the surface, with the discharge pipe terminating 10 feet above the surface. The total lift is therefore 440 feet, and the curves show the following results: the minimum submergence recommended for this lift is 35 per cent; the well depth must be at least 243 feet plus 430 feet, or 673 feet; the minimum air pressure is 106 pounds per square inch; and the probable air consumption is 2.20 cubic feet of free air per gallon of water pumped.

Similarly, the curves show that to get the best economy in power, the submergence should be 40 to 45 per cent; the well depth should be between 730 and 770 feet; the minimum air pressure should be between 300 and 340 pounds per square inch; and the probable air consumption will be between 1.60 and 1.40 cubic feet of free air per gallon of water lifted.

In case the submergence in feet is wanted closer than the curves indicate it, the exact value can be calculated from the formula:

*Asst. Prof. Mechanical Engineering, The Rice Institute.



$$\text{Submergence in feet} = \text{lift in feet} \times \frac{\%\ \text{submergence}}{1 - \%\ \text{submergence}}$$

This formula can easily be represented by curves plotted submergence in feet against lift in feet, with a separate straight-line curve for each per cent submergence likely to be considered.

In addition to simplifying calculations, this curve has the advantage of indicating graphically the effect on air consumption of changes in lift and in submergence. The results of such changes are not always evident from formulae and tables of constants, so they are often unappreciated by operators and engineers. Expressed in words, the curves show these trends:

The air consumption in gallons of water pumped increases as the lift increases.

For a given lift, the air consumption per gallon decreases as the submergence increases, but the air pressure required increases.

The most economical per cent of submergence, considering both air consumption and air pressure, decreases as the lift increases.

WIRING ELECTRIC CONDUITS WITH COMPRESSED AIR

NOT so long ago we described in this Magazine how compressed air is employed by the New York Edison Company in lubricating conduits that are ready to receive electric cables. Therefore, it should be of interest to learn that the Detroit Edison Company makes use of the propulsive power of compressed air to wire conduits preliminary to pulling the cables through. Heretofore, a jointed push rod has served to thread a cable, now the wire is attached to a "bullet" that is shot through under air pressure. The bullet was developed by the assistant superintendent of the underground lines department of the Detroit Edison Company, and consists of a number of soft-rubber washers, separated by aluminum spacers, mounted on a metal rod with an eye at each end. The washers are slightly larger in diameter than the conduit.

The sealing of the duct is effected by a plumber's test plug fitted, for this service, with compressed-air connections, a throttle valve for the control of the air, an orifice for the wire, and an adjustable support for bracing the plug against the opposite wall of the manhole. This is necessary so as to prevent the plug from being forced out should the pressure within the conduit become too high. With air at 50 pounds pressure at the plug, and in a well-laid fiber duct, the bullet will carry the wire approximately 400 feet a minute.

This method of wiring is suitable for all types of conduits that are sufficiently tight to permit the building up behind the bullet of air pressure high enough to force the missile with its trailing burden through. The portable compressor, which can be moved quickly from point to point and deliver air at a moment's notice, has made it possible to bring about this improvement in method and to effect considerable savings both in operating time and cost. To be specific, a No. 12 gage galvanized-iron wire can be run through a certain kind of duct five times as fast as by rodding, and at one-fifth the cost.

(We are indebted to the Electric World for the facts contained in this article.)

The latest addition to the library of educational motion pictures maintained by the United States Bureau of Mines for the benefit of the public is a film entitled, *The Heat Treatment of Steel*. Copies of this film can now be borrowed, free of charge, by institutions of learning, engineering societies, and the like; and application for its use should be addressed to the Pittsburgh Experiment Station, United States Bureau of Mines, Pittsburgh, Pa.

Industry, we are told, is now absorbing annually 5,000,000 ounces of gold worth $100,000,000.

Suction Dredge Adopts Oil-Engine Drive

This Form of Prime Mover Has Widened Craft's Field of Service and Greatly Reduced Her Operating Costs

By C. H. VIVIAN

ANYONE possessed of an insatiable gambling spirit would do well to investigate the dredging business. It offers speculative opportunities as fascinating as those of Wall Street or Monte Carlo.

The dredgeman works literally in the dark; his field of endeavor is underwater; and his eyes are of little help. He must feel his way. He cannot survey his scene of action beforehand. Harbor bottoms and river bottoms are chock-full of surprises, and the dredger is the man that meets them. Each situation calls for its own method of treatment. The dredger must be able to size up a job from incomplete data and determine the best procedure to follow. If he errs, he must change his method of attack.

There are two principal types of dredges—dipper and hydraulic or suction dredges. The dipper type is essentially a floating power shovel that scoops up the material to be excavated. The hydraulic dredge draws up water—and with it bottom material—through a pipe and discharges it by the same means. The point of deposition may be several thousand feet away from the dredge, thus adding the problem of transportation to that of excavation. Suction dredges can now be built to deal with any material that a dipper dredge could handle, except blasted rock. This article is concerned only with the suction dredge.

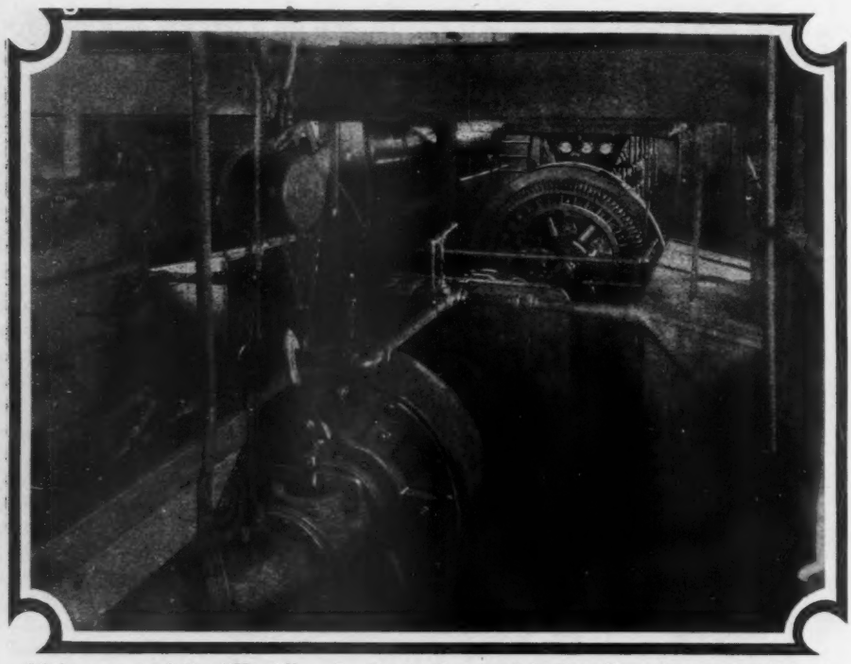
Some of these dredges are elaborate structures that cost $1,000,000 and upwards, but the bulk of the work is done by a miscellany of smaller craft. Those on contract work roam the coasts and rivers, bidding for and do ing whatever they can get to do in their line just as a building contractor moves about according to where he can sell his services.

The principal uses of dredges are to create and to deepen waterways—the dredgeman calls it "making water." The material dredged is usually waste which has to be disposed of by the most convenient means available. In other cases, it is the bottom material that is sought. Sometimes it bears metal that can be recovered; but more often it is merely sediment that can be utilized only to make a needed fill, or to build a levee or a road.

Suction dredges have been in use for about 40 years. One of the first works on which they were employed was the digging of the Amsterdam Ship Canal in Holland. The pioneer dredges were powered by steam. In recent years electric-motor drive has been accepted as the most satisfactory power medium available. The favored present practice is to generate electric power aboard by Diesel engines direct connected to generators. One engine-generator unit serves for small and medium-sized dredges: larger boats require two or more such units.

Though varying in size and details, suction dredges are generally similar in construction An "A" frame or ladder of fabricated steel, hinged at its broad end to the bow so that it can be raised or lowered as desired, carries the digging mechanism and the intake or suction pipe. The cutter head, a bladed tool of steel shaped not unlike an electric fan, is revolved by means of a shaft. It loosens and agitates the bottom material and mixes it with the water, which is drawn up through the pipe on the underside of the ladder and with its opening just back of the cutter head. The ladder is suspended from a cable secured to its outer end and passing upward and over a sheave at the tip of a similar "A" frame

1—Discharge end of the pipe line extending back to the Calkins "No. 5", which is pumping material for roadbuilding from the bed of the Cape Fear River. 2—Discharge pipe resting on top of the made ground. 3—System of pontoons carrying the section of the pipe line leading from the dredge to the shore. 4—How the line was supported on shore at a height level with the crest of the road under construction.



Main pump of the "No. 5". In the background is the oil-engine generator set that supplies the power for operating the dredge.

above it. This second frame is supported by cables passing over a gantry placed amidships. Raising and lowering the ladder and swinging the dredge are accomplished through winches and drums in the bow.

A second gantry, at the stern, is equipped with sheaves for raising and lowering two spuds, one at either side. The spuds, uprights of timber or steel, are long enough to reach bottom at the maximum working depth of the dredge. The digging spud anchors the boat while it is at work—serving as a pivot on which the dredge swings through its digging radius. The swing is imparted by means of guy lines extending to either side from winches in the bow. These lines are made fast to objects on shore or, when this is not feasible, to anchors. A pull can be exerted on either of these lines, as desired. When the boat is to be moved forward into a new position, the digging spud is raised and the other spud or pivot is lowered so as to swing the dredge around. The spuds are, in effect, a pair of legs on which the dredge goes from point to point much as a stiff-legged man advances by raising each foot alternately and swinging his body around on the one on the ground. The spuds are operated by means of a double drum located at the bow.

The dredge is controlled from the pilot house in the bow—the operator being in such a position that he can see the bow and, by turning, the stern and the spuds as well. Convenient gages keep him informed as to the pressure and suction available. Dredges are rated in capacity according to the diameter of the suction pipe, 24- and 30-inch dredges now being fairly common. Of prime importance in the operation of a dredge is the pump, which is of the single-stage, centrifugal type specially built for this field of service.

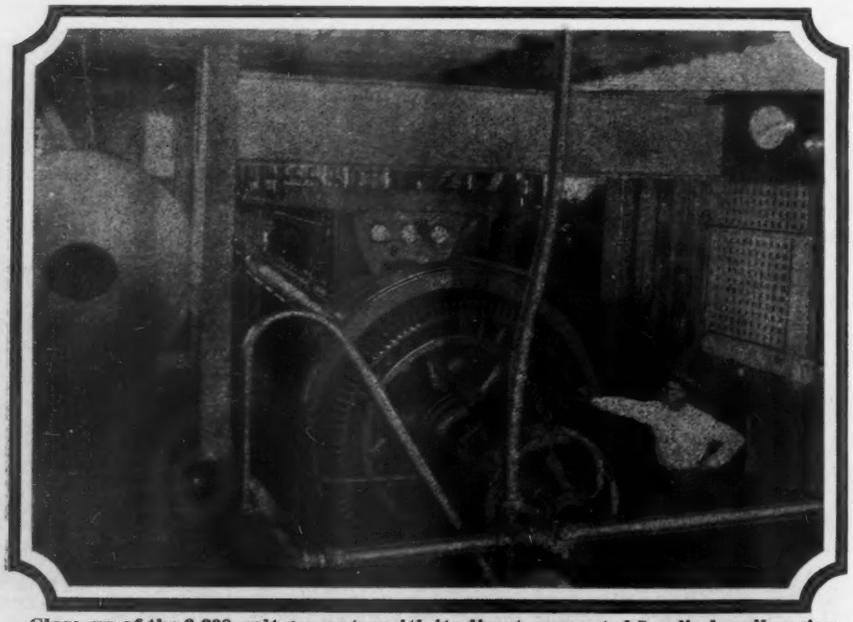
The easiest material to handle is sand mixed with mud. Clay tends to plug up the discharge line. The ratio of solid matter to water that can be pumped depends upon the material, the distance of pumping, and other factors. With good material, the discharge will run from 12 to 15 per cent solids. The dredger who contracts his jobs first samples the material. He next estimates from experience the speed with which it can be dug and the percentage of solids that can be conveyed. He is then able to determine with some degree of accuracy the amount of yardage he can move per day—basing his cost for the job on these figures.

Foreign materials—such as stumps, sunken piles, débris, etc., are frequently drawn into the suction line, stopping the pump. This necessitates opening the suction pipe just in front of the pump and removing the obstruction. This is accomplished sometimes only after considerable effort, and much valuable running time is lost. Maintaining an average of twenty hours of actual pumping each 24-hour working day is considered very good performance.

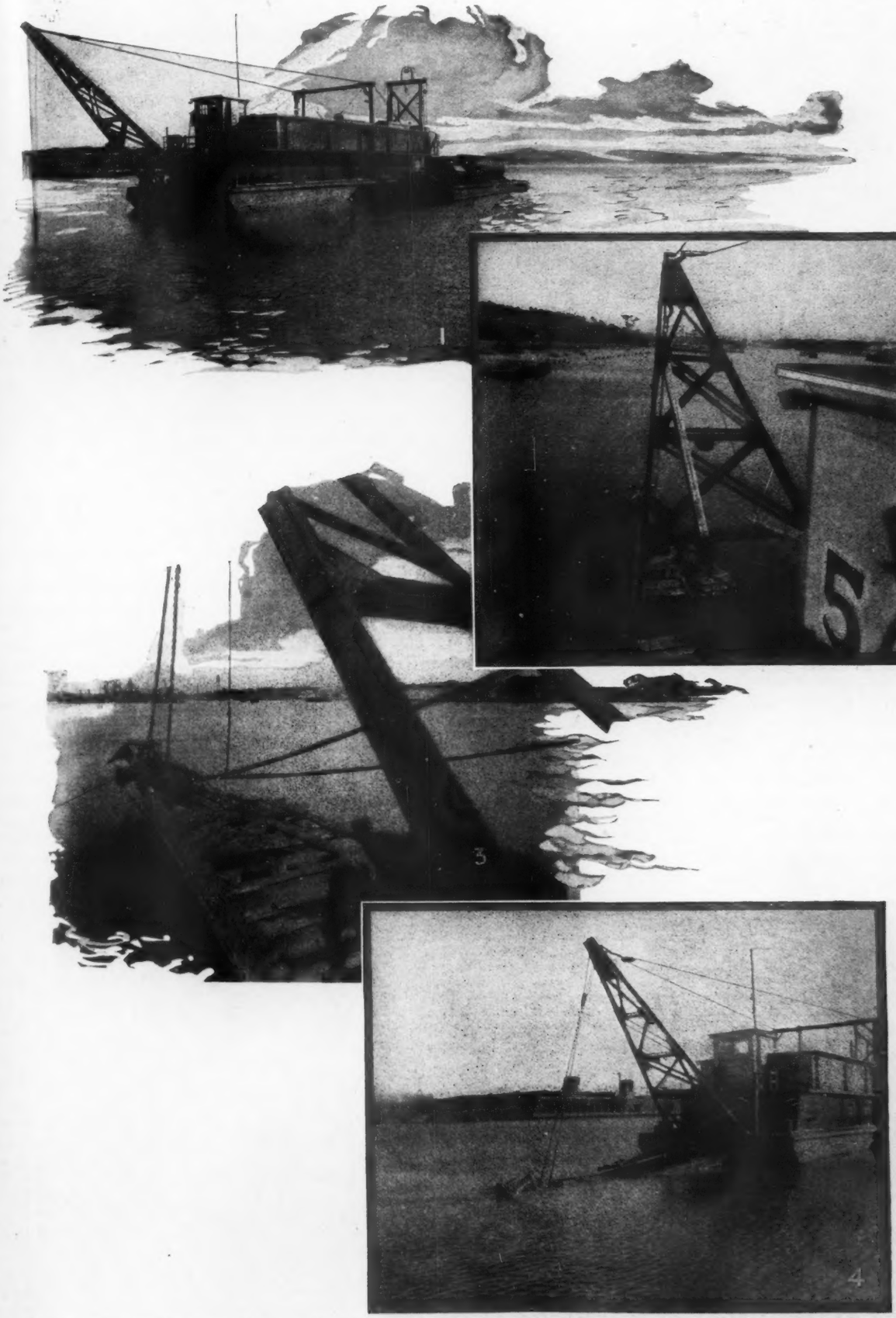
The Calkins *No. 5* is a dredge such as has been briefly described. It is owned by the Calkins Dredging Company of Norfolk, Va., of which J. D. Calkins is president and general manager. Mr. Calkins is a veteran in the excavating business. He ran and superintended the running of steam shovels on many important engineering projects in the West, including the Hetch-Hetchy development insuring the City of San Francisco a supply of mountain water. He was a construction superintendent for Stone & Webster for several years, during which time he worked in various parts of the country. About twelve years ago he turned his attention to dredging and since then has followed that line as an independent contractor.

The *No. 5* was built in 1925 as a 15-inch dredge. It has a wooden hull 100 feet long with a beam of 30 feet, a depth of 8½ feet, and a working draft of 4½ feet. The superstructure contains an office and quarters for a crew of 30, with galley and dining room aft. The boat was designed for all-electric operation, taking current through a cable connecting with power lines on shore. It operated as such until the summer of 1928, when it was decided to convert it to Diesel electric drive because of the numerous advantages and economies that such drive offered.

The conversion was made in a remarkably short time. The dredge was originally laid out with the idea of some day installing a Diesel engine, and few alterations were re-



Close-up of the 2,200-volt generator with its direct-connected 5-cylinder oil engine, in the background.



1—The Calkins "No. 5" at work with an oil barge alongside. 2—The A-frame ladder and its supporting structure as seen from above. 3—The ladder elevated, showing manner of mounting the cutter and the cutter shaft. 4—Another view of the digging mechanism.

quired to make it ready. The engine was ordered on July 2 of last year. It was shipped assembled, and was installed at the Norfolk Navy Yard. The dredge started digging on August 16. The housing was built over the engine while the boat was at work.

The Calkins *No. 5* is powered by an Ingersoll-Rand Type PR 5-cylinder, 17¾x22-inch oil engine rated at 600 hp. at 240 revolutions per minute. This engine is of the solid-injection type, in which two opposed nozzles spray atomized fuel into the combustion chamber. It operates on the 4-cycle combustion principle. The fuel requirement at full load ranges from .41 pound to .45 pound per brake horsepower-hour, when using fuel of 18,500 B.T.U's. The oil engine is direct connected to a General Electric 2,200-volt, 3-phase, 60-cycle, alternating-current generator rated at 400 kw. at 240 revolutions per minute. The 125-volt, 15-kw. exciter is of the direct-connected type.

The power thus generated serves to operate, through motors, all the machinery aboard. The only auxiliary provided is a 4½-kw. generator driven by a gasoline engine. This supplies current for lights and for an electric refrigerator at times when the Diesel engine is not running. Power is fed to 2,200- and 220-volt switchboards. The potential is reduced through transformers to 220 volts for operating some of the motors and to 110 volts for the lighting circuit and the refrigerator.

The maximum power requirement, with all motors running, is from 640 to 650 hp. Obviously, the full load is seldom if ever demanded. Normally, the pump consumes from 80 to 85 per cent of the power. The 2,200-volt, 400-hp. General Electric pump motor is of the variable-speed type, with 11-point control, and operates at from 300 to 600 revolutions per minute, according to the load on the pump. The control is in the engine room. The pump, itself, is of the heavy-duty dredge type and is made of manganese steel. It was built by the Morris Machinery Works.

The cutter is driven by a Westinghouse 150-hp., slip-ring motor making 500 revolutions per minute; and the power is transmitted to the cutter driving shaft through reducing gears and knuckle-and-slip joints. The cutter head operates at 20 revolutions per minute. For the winding gears, consisting of five drums and used for swinging the dredge and raising and lowering the ladder, there is a 50-hp., 220-volt, slip-ring motor; for priming the main pump, for fire protection, etc., are provided two service pumps each driven by a 10-hp. motor; a stand-by high-pressure pump draws power from a 20-hp. motor; a 5-hp. motor operates the circulating-water pump for the main engine; and a 3-hp. motor serves to run a lathe in the machine shop.

The advantages of Diesel power on such a boat are readily apparent. With its power plant aboard, the dredge is free to work wherever it can find a job. Before the change was made it was dependent upon power lines on land and could not bid on work where energy so transmitted was not available within a reasonable distance. Thus, its flexibility has been greatly increased.

The well-known economies of Diesel engine operation offer an even more important advantage. Aside from the reduced power costs, the delays in starting work and the expense incidental to stringing electric lines from the shore to the dredge, erecting transformers, etc., have been eliminated. As the earning capacity of the *No. 5* is from $600 to $1,200 per day, this saving in time and effort represents a considerable item in the course of a year.

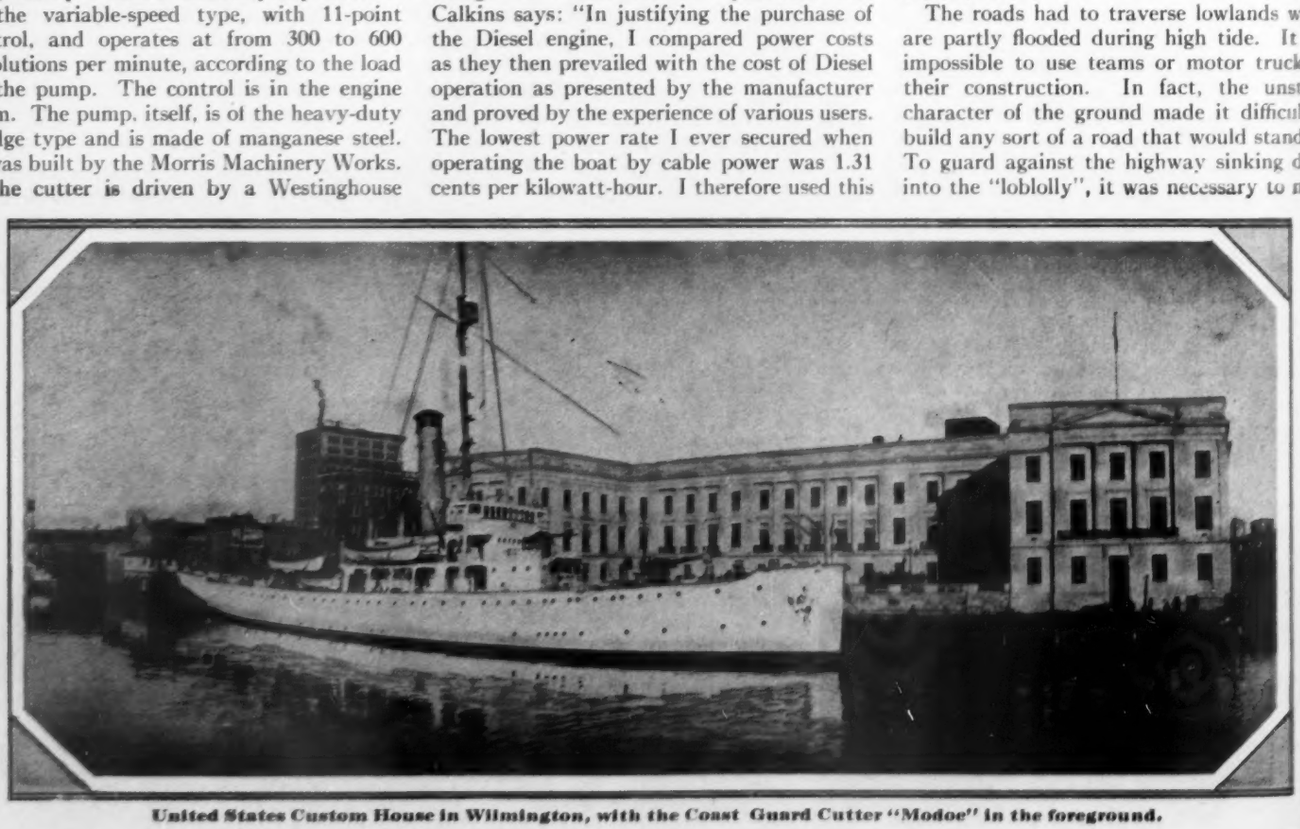
Regarding the savings effected and the reasons that prompted the conversion of the dredge to Diesel electric operation, Mr. Calkins says: "In justifying the purchase of the Diesel engine, I compared power costs as they then prevailed with the cost of Diesel operation as presented by the manufacturer and proved by the experience of various users. The lowest power rate I ever secured when operating the boat by cable power was 1.31 cents per kilowatt-hour. I therefore used this as the basis of comparison. At this rate, normal operation of the dredge for a month would cost approximately $3,000 for power. The cost of the power as now generated by Diesel engine is but $1,200 for the same period of operation."

A direct saving of $1,800 a month is shown for the present power plant under the conditions just outlined. Since the cost of cable power, in the past, has been as high as 4 cents per kilowatt-hour, or more than three times the sum taken by Mr. Calkins in making his comparison, it is readily apparent that the economies of the Diesel engine installation are pronounced. The average cost of fuel oil on which these figures were based was 5½ cents a gallon.

The accompanying illustrations show the Calkins *No. 5* at work in the Cape Fear River at Wilmington, N. C., and at a point where the Northeast River, a branch of the Cape Fear, and the Cape Fear River meet. At the time they were taken, the Calkins Dredging Company was engaged on a contract for the building of two sections of roadway 5,700 feet in length.

Five major highways converge upon Wilmington. Up to the present time no bridge has been available there. However, by authority of the state legislature, the state highway commission is building two lift-type steel bridges to span the two streams just above their confluence. A new road 3,400 feet long was required to connect the two bridges, while a stretch 2,300 feet long was needed to join an existing highway with the bridge across the Cape Fear. The cost of the bridges and highways will approximate $1,250,000.

The roads had to traverse lowlands which are partly flooded during high tide. It was impossible to use teams or motor trucks in their construction. In fact, the unstable character of the ground made it difficult to build any sort of a road that would stand up. To guard against the highway sinking down into the "loblolly", it was necessary to make



United States Custom House in Wilmington, with the Coast Guard Cutter "Modoc" in the foreground.

Day crew of the "No. 5" with J. D. Calkins, president of the Calkins Dredging Company, at the extreme right.

the road broad at the base, with a gentle slope toward the crown, thus giving it a substantial bearing surface and distributing the weight over a wide area. The state highway engineers specified a road averaging 30 feet wide and 5 feet high at the center with a 5 to 1 slope on either side. This called for a width at the base averaging 80 feet.

The method followed was to construct a board fence or retaining wall along the base lines on either side. This formed a loose impounding cofferdam into which dredged material could be pumped and which arrested the runoff sufficiently to allow the solid material to settle out within its confines. The dredge discharge line was carried by means of a wooden supporting structure at a height level with the crown of the finished road. Holes in the bottom of the line allowed a portion of the suspended material to drop out before the end of the pipe was reached, thus filling in approximately 100 feet at a time. When the fill attained the required height, the discharge line was resting on top of it. By adding lengths of piping the line was extended, and another section built up in the same way.

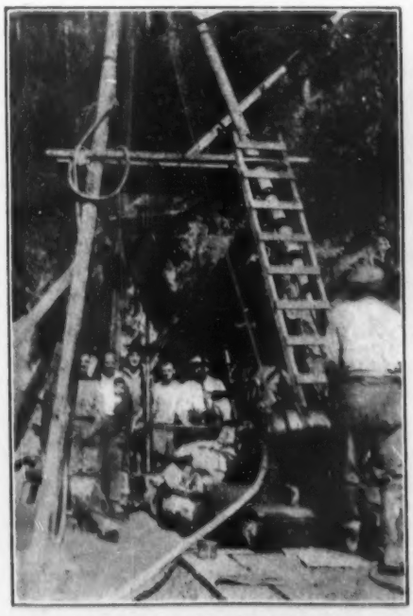
There was some settling of the material due to the evaporation of the water. However, there was a big surplus of yardage over that specified; and by taking material from the sides the crown of the highway was built up to the required height.

The dredge took material from the nearest available location, working in whatever stream happened to be closest to the scene of operations. The discharge line was carried from the dredge to the shore on pontoons, as illustrated. The maximum pumping distance was approximately 5,000 feet. An average of about 12 per cent of solid material was carried; and it was possible to pump as much as 5,000 yards of material per day.

While this type of road is not in itself new, highway engineers are recognizing more and more the pronounced stability of a roadway built on such a fill and having so wide a supporting base.

GROUT SEALS LEAKY DAM

A LEAKY dam, about a mile above the main tunnel of the zinc-lead ore mine of the Consolidated Mining & Smelting Company—the famous Sullivan at Kimberly, B. C., Canada, caused that company considerable concern not long ago and prompted it to take immediate steps to assure its watertightness by the application of grout. To get down to bedrock, it was necessary to penetrate from 40 to 75 feet of sand and gravel; and this work was first done, but unsuccessfully, by means of a diamond drill. This failing, a churn drill was rigged up on the spot: the diamond-drill rods were fitted with smaller bits of a special type, and a 10 HL air-operated hoist was used to raise and to drop the rods a distance of 5 feet. And so as to get greater speed of action, the hoist drum was built up from a diameter of 6½ inches to 14 inches. The hoist also proved helpful in driving into the ground the 2-inch casing through which the grout was forced. The drill holes were spaced 10 feet apart.



The improvised churn drill at work sinking deep holes preparatory to grouting a leaky dam.

After the casing was in contact with bedrock it was raised a few inches in order to provide an outlet for the cement, which was applied with compressed air and under a pressure of 100 pounds per square inch. Grout was fed into each drill hole to refusal—one hole requiring as many as 65 bags of cement. Thus the lower strata of gravel was bound into a solid mass and all leaks effectually sealed without much difficulty.

HANDLING OF DRILL STEELS IN MINE SIMPLIFIED

THE North Star Mine, at Grass Valley, Calif., uses a system of transporting drill steels that has cut out all unnecessary motion. Between the sharpening shop and the levels, the bundles of steels, which were formerly put right into a special type of cage car, are now handled in a bucket that is carried by the cage car. This bucket is made of a pipe section having a welded bottom and an elongated side against which to rest the steels.

At each level, where it is necessary to convey the bundles to the inclines, a "Little Tugger" hoist is installed on a crab and rail above the tracks. This air-driven hoist lifts the bucket with its burden out of the cage car and transfers it to the material car in the incline shaft. This system of handling drill steels has saved the management many man-hours formerly spent in getting the steels to and from the blacksmith shop.

The second national meeting of the Oil and Gas Power Division of the American Society of Mechanical Engineers will be held, as was the case last year, at the Pennsylvania State College, and from June 24 to 27, inclusive.

Sand Blast Beautifies Woodwork

This Adaptation Promises to Prove Profitable to Mills Engaged in Turning Out Architectural Lumber

By A. S. TAYLOR

HAND-CARVED panels and hand-carved friezes still grace those older homes, offices, and other interior spaces that were mainly fashioned when the skilled woodworker was satisfied with a much lower rate of compensation than he now asks for kindred evidences of his craftsmanship.

Most of us that appreciate such art would like to have our present-day habitations or our business sanctums similarly embellished, but relatively few of us would feel justified in going to that expense if the decorating were done by hand. Indeed, we should probably have to hunt far and long to find men qualified to do such carving. But the situation has changed latterly; and it is now possible for persons of even moderate means to have about them panels, wainscoating, friezes, etc., that are beautifully carved by a mechanical process that bids fair to revolutionize the finish of architectural woodwork both for interior and exterior applications.

Sand-blasting is the medium today employed to do quickly the cutting that has in the past been done laboriously with steel tools guided by the cunning hand of expert workmen. So far as we know, this utilization of the sand blast originated but a short while ago among some of the wide-awake lumber companies of the Pacific Coast; and a number of them are now engaged in amplifying this adaptation of the sand blast—several of them being actively occupied in turning out artistic products that are winning wide and enthusiastic favor. It was our privilege recently to visit the Oakland, Calif., mill of the Chicago Lumber Company of Washington; and the accompanying article is based upon what was seen there. It is one more evidence of how the enterprising and ingenious lumberman is finding new and profitable ways to employ compressed air.

This sand-blasted panel illustrates how the abrasive particles cut away the soft wood and leave in high relief the grain of the hard wood.

The effective use of the sand blast in cutting designs in wood is largely dependent on the employment of lumber that has been sawed so as to expose the vertical grain of the wood to the abrasive action of the sand. That is to say, the sharp particles of sand, when propelled by a blast of compressed air, cut out the soft wood of the summer growth that lies between the hard grain formed during the growth that takes place in the winter months. The net result is an arrangement of paralleling ridges and depressions—the formation depending upon the nature of the wood and its characteristic grain—that produce a background differing in its texture from the smooth surface of the normal wood that forms the body of the figure or design.

The problem for the operator is to cut away only enough of the soft wood to emphasize the remaining hard grain, otherwise he might cut away too much of the hard grain and thus give to the "engraved" background an undesirable flatness. Each wood used has to be handled differently in order to insure satisfactory and pleasing results. At the Oakland plant, this method of decoration has been used effectively on sugar and white pine, Douglas fir, redwood, and certain Philippine hardwoods. As a matter of fact, the practice is virtually in its infancy so far as woodworking is concerned; and it is highly likely that some marked and astonishing developments may occur in the near future.

The monumental or decorative stonecutter blazed the way in this field of industrial art; and what the stonecutter has done will make it easier for us to appreciate what the woodworker is doing. Let us assume that a flat

An artistic panel of California redwood that was carved with the sand blast. Note the clean-cut edges of the design.

Stencils mounted in protecting frames to facilitate handling. The supporting material is bakelite.

stone surface has been suitably finished and made ready for decorating or for the cutting of an inscription. The surface of the stone is covered with a protecting elastic coat about ⅛ inch thick—applied hot so that it can be spread evenly and will solidify quickly. The design is transferred thereon by tracing the outlines on a suitably prepared sheet so as to leave an impression in a sharply contrasting color. The stencil is completed by cutting out with a sharp penknife the necessary parts of the coating in order to expose the underlying stone for the sand-blast effect. Any mistake made in cutting the stencil can be promptly corrected by recoating the area concerned and then making the needful changes.

In the case of the woodworker, however, the procedure is somewhat different because his object usually is to make a number of identical pieces, and this would not be practicable and economical if he coated each piece and cut a separate stencil for it. In other words, one stencil must suffice for the sand-blasting of a number of similar panels, strips, etc. At the Oakland plant of the Chicago Lumber Company, the design or pattern to be reproduced on the wood is first developed upon a thin sheet of bakelite. A soft rubber-like composition is used for this purpose; and, depending upon the number of reproductions, the coating may range in thickness from 1/32 of an inch to something less than ⅛ inch. The coating material is heated to make it flow easily and to facilitate tracing the more delicate lines of the decorative design.

With the design finished, the sheet is turned over to the sand-blaster and secured to the surface to be treated. The first action of the sand blast is to cut away the bakelite where not protected by the elastic and repelling coating. Next, with the stencil completed by this action, the abrasive particles of sand are free to attack the exposed areas of the wood—the sharp granules performing the part of a myriad of minute chisels or graving tools. The depth of the cutting depends upon the force of the sand blast and the length of time to which the wood is exposed to the blast. Plainly, much hinges upon the skill of the operator; and this is especially true whenever he is called upon to produce a number of pieces that must be used together, and, therefore, match.

A well-made stencil will endure long enough to permit from 50 to 75 repetitions; and it is customary to patch up a stencil with the protecting composition from time to time as the oblique attack of the sand particles tends to undercut the supporting foundation of bakelite. In practice, it is feasible to cut away the wood with the sand blast to a depth of ⅜ of an inch; but this high relief is not commonly required in providing an effective contrast between the background and the normal surface of a design.

All stencils are not made in the manner previously described. In some cases, sheet rubber—much like that used for patching strips for mending automobile inner tubes—is utilized. A stencil of this sort is much more flexible than one built up upon bakelite, and lends itself readily to placing on curved surfaces—such as pillars, columns, etc.—that are to be carved by means of the sand blast. This merely illustrates the way in which the woodworker is cunningly adapting this new method to meet his changing requirements and to add to the scope of its employment.

The sand used at Oakland is what is commonly known in that part of California as Monterey sand—a sharp beach sand; and it has proved satisfactory so far. The sand-blasting machine is of a well-known type, slightly modified to permit the operator to vary the vigor of the blast by a simple lever movement. The nozzle used is ⅜ inch in diameter and is generally held perpendicular to the surface to be cut. This is essential lest the abrasive sand undercut the stencil and alter the lines and contours of the design. The action of the blast can be increased or diminished by advancing or retiring the nozzle in relation to the stencil.

The decorative effect of sand-blasting can be intensified or heightened by staining the panel with a flat tint and then wiping off the uncut surfaces. This leaves a dark background for the lighter uncolored design. The artistic value of the work can be increased still further by the use of various tints on different parts of the decorations. It is equally possible to sand blast wood finished on the flat grain. The sand blast wears away the softer wood and brings into relief the harder wood of the winter growth. This gives the lumber a weathered appearance—the sand blast producing in a few minutes a surface condition similar to that resulting from years of exposure to the elements. Certain kinds of lumber and certain structural forms of wood can be "aged" in this manner and utilized to impart various pleasing architectural effects.

The air supply for the sand-blasting equipment in this plant is provided by a 9x8-inch ER compressor fitted with an automatic start-and-stop attachment. The machine is housed in a pit below the mill floor, and, therefore, somewhat screened from circulating sawdust. The mill superintendent explained that the location was chosen because it left free just that much more floor space. In answer to the query: "How about accessibility?" He answered: "We don't have to bother about that because the compressor virtually takes care of itself—needing nothing more than lubricating oil occasionally."

Redwood panel for advertising purposes carved with the sand blast.

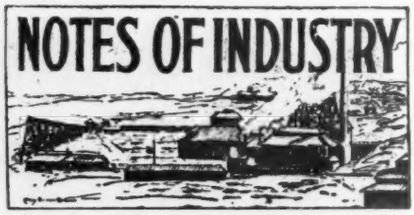
Sand-blasting equipment used in the Oakland plant of the Chicago Lumber Company of Washington.

It is inevitable that what has been done with sand-blasting by alert woodworkers on the Pacific Coast will be followed sooner or later by other enterprising woodworkers throughout the country; and the architectural fraternity as well as the final possessors will have ample reason for rejoicing in this new departure.

VACUUM AND AIR PRESSURE IN SURGERY

THE use of suction in surgical work, writes Dr. Edward King in the *Eye, Ear, Nose, and Throat Monthly*, has increased very much during the past few years. The general surgeon is employing it extensively; and in operations about the nose and throat, especially in bronchoscopy and esophagoscopy, suction is indispensable. Most of the machines available for this service make enough noise to be distracting to the operator and are a source of annoyance to the anaesthetist who must observe the breathing of the patient. In large hospitals it is necessary to have a number of such machines to answer the needs of the surgeons. With these facts in mind, the director of the operating rooms of the Good Samaritan Hospital, in Cincinnati, Ohio, has installed recently apparatus which not only overcome the aforementioned objections but provide all the suction needed in the hospital's nine operating rooms.

In each of these rooms, located in the center of one of the floors, and under the operating table, there is a brass receptacle, 8 inches square, covered by a portable lid level with the floor. Each receptacle has two valves—one for vacuum and one for compressed air—from which pipes lead to a room below containing a motor-driven vacuum pump and a motor-driven air compressor, both of Ingersoll-Rand make. The suction is controlled by a needle valve placed in the rubber tubing leading from the patient to a large waste bottle. If compressed air instead of suction is to be employed, it is necessary only to shift the tubing from the suction valve to the air valve in the brass receptacle. It is the practice at the Good Samaritan Hospital to apply ether under pressure.



At the present rate of progress, the Welland Ship Canal should be open to navigation throughout its entire length by the middle of 1930.

In experimenting with methods intended to expedite the extraction of soluble copper from ores during leaching, the Southwest Experiment Station of the United States Bureau of Mines at Tucson, Ariz., has discovered that the copper content comes to the surface much more rapidly by alternately wetting and drying the ore than by vat-leaching flood-washing methods. Tests so far made have revealed that a half-hour wash followed by four hours of drying at a temperature of 95° F. considerably speeds up the extraction of the soluble copper.

Some of Boston's street lamps are now turned on and off by radio. When waves of 720 cycles a second are sent along the light wires, the small receiver placed in the base of each lamp in that system moves a switch which connects the lamp with the lighting circuit. Conversely, when the frequency is 480 cycles, the receiver pulls a switch that disconnects the lamp.

To cover the 21 air-mail routes now operating in the United States, the big trimotored planes in this service consume daily 60,260 gallons of high-grade gasoline and 3,240 gallons of lubricating oil.

What is said to be the largest cofferdam ever constructed is now in use in connection with the development of St. John Harbor, New Brunswick. It is 4,300 feet long by about 300 feet wide, and encloses one of the two new piers projected.

With an aggregate production in 1928 valued at approximately $260,000,000, the mining industry of the Dominion of Canada has without doubt established a new high record. This estimate by the Canadian Bank of Commerce is based on authoritative reports, and represents an increase of 5 per cent over the 1927 output.

The total capacity of the water wheels in hydro electric plants of 100 hp. and more operating in the United States on January 1, 1929, amounted to 13,571,530 hp., an increase of 10.4 per cent during 1928.

The world's largest iron deposits are said to exist in the State of Minas Geraes, Brazil. They are estimated to contain some 12,000,000,000 tons of ore of the highest grade and lying close to the surface.

Investigations now being conducted by the direction of the Hawaiian Sugar Planters Association may lead to the introduction into those islands of a new industry—that of manufacturing pulp for paper-making from waste sugar cane, that is, bagasse.

On January 1, 1929, a total of 24,592,370 motor vehicles—21,468,596 passenger cars and 3,123,774 trucks—was registered in the United States, or 1,463,055 more than in 1928.

To prevent the piling up of waste rock on top of hidden ore bodies, the Asbestos Corporation of Canada has begun an exploration job on an unusually large scale. This work of examining its property will involve putting down something like 60,000 feet of holes by the use of diamond drills.

The Alhajuela Dam, situated on the Chagres River and lying halfway between Colon and Panama City, is being erected to impound water during the rainy season for use in the operation of the Panama Canal when the waters in Lake Gatun drop to a low level in the dry season. Five years will be required, so it is estimated, to complete the work.

A 20-mile electric line will soon connect the world's smallest republic, lying in the heart of Italy, with rail head at Rimini, in Italy. San Marino is situated on top of a precipitous rock, 2,437 feet high, and, in the past, could be reached only by carriage or automobile from Rimini. The project involves the building of three stations, a bridge, and ten tunnels.

Estimates made by the United States Bureau of Mines have placed the value of the 1928 mineral output of the United States at $5,400,000,000, in round figures.

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EDITORIALS

STATUS OF AUTOMOBILE INDUSTRY

IS the American automobile industry overdoing production? Can it confidently count upon disposing of its output? These queries are provoked by a review of the industry lately made by the National Bank of Commerce in New York. We quote from that analysis of the situation.

"Competitive efforts of automobile manufacturers to expand their sales are being watched with increasing attention. Production in 1928 was less than 1 per cent above the output in 1926, and that by grace of an increase in exports. Sales in the domestic market were lower than in either 1925 or 1926, and were only at the level of 1923 despite an accumulated demand carried over from the preceding year. Whether much of a new record can be established this year is plainly a debatable question.

"In view of the rapidly rising trend of exports and the growth of the replacement market, it seems not unlikely that under favorable conditions an output of 4,750,000 to 5,000,000 units can be disposed of. The possible existence of some unfilled shortage carried over from 1928 and the stimulus of lower prices, together with high-pressure salesmanship, contribute to this conclusion. Conceding the possibility, however, the present very high rate of production can hardly be continued long except at the expense of the industry's well-being in the latter part of the year."

Surely none of us want to see this outstanding industry hurt by its own excess efforts because it is linked vitally with so many departments of our manufacturing life.

IS A COLLEGE EDUCATION AN ADVANTAGE?

CONSIDERABLE discussion has recently been provoked in the daily press because one eminent educator declared that a college education, instead of being an aid, is very often hampering to the earning capacity of the college-trained American youth—the reason in part being largely due to overcrowding in the professional fields. The battle of conflicting opinions has still left the main question unsettled.

There are probably but few of us—and that few so self-absorbed that they have not looked around them—that cannot point to numerous college fellows who have made little if any use of their special training; and it is equally possible to point to men that have succeeded admirably in fields of service alien to those for which they were specifically educated. Neither class can be held up as a horrible example of educational failure.

Unsuccess is not due to the educational course, *per se*, but is the consequence of a training that was not suited to the capacity or the natural bent of the individual. In this day of intense specialism in so many departments of life, it is inevitable that a goodly percentage of the college-bred fraternity will find themselves out of step and, incidentally, out of a remunerative job gaged by their own conceptions of what their talents are worth. Much of this disappointment is due to the fact that the unfortunate alumnus did not know what he had in him, what his particular qualifications were, before he chose the course he took in college.

As we see it, the crucial question is not merely the advantages or disadvantages of a college education, but whether or not the academic training is the best one for the individual in order to make him a happy and a useful member of society. In education, as in other things, there are all too many examples of the square peg trying to fill out a round hole, and *vice versa*. and the educational millenium and the highest state of human effort will come only when means will have been devised by which each of us can be measured and evaluated in the formative years of early youth and then directed into those paths of instruction and learning that will open to us fields of employment that will arouse our enthusiasm and our best efforts. Perhaps that day of enlightenment will find our colleges and our universities still more crowded than they are today, and, conversely, we may find more of those men that now go to college, but who make comparatively little use of that training, going directly from school into walks of life where success rests in the main upon experience and practical work.

EXPLORING FOR POTASH IN THIS COUNTRY

WE are authoritatively informed that substantially 250,000 tons of potash are consumed in the United States annually, and that the value of this essential substance ranges between $15,000,000 and $20,000,000. Fully 95 per cent of this potash is required to enrich the soil for the raising of our food stuffs; and in all likelihood not more than 20 per cent of this supply is obtained normally from domestic resources. Certain crops would be indifferent or commercially of comparatively little value if they did not reach that market standard that is made possible by giving back to the farmlands the necessary measure of potash.

Such being our dependence upon foreign sources of potash, we begin to realize the importance of the work being carried on by the Bureau of Mines to discover deposits within our own boundaries. It will be recalled that Congress, in 1926, authorized an investigation of possible potash deposits, and funds for the purpose were provided. Exploratory work has since been done with the core drill in the extensive salt beds of New Mexico and western Texas; and at the very start encouraging discoveries were made—discoveries that indicated the presence of potash salts although not in quantity or quality of commercial value. However, in the third hole drilled, nine beds or groups of beds of potash salts were penetrated within 1,500 feet of the surface, and one of them was nearly 9 feet thick and contained 11.1 per cent of potash. The fourth hole struck a bed 6 feet 7 inches thick that carried 12.8 per cent of potash. Something like eleven holes have been drilled, and well-nigh all of them have indicated the presence of potash in varying measures. It may be merely a question of time before the drills reveal, at workable depths, deposits that would render us independent of alien sources of supply. The Bureau of Mines has a sum of $100,000 available for potash exploration during the fiscal year of 1928-29.

In sinking the test wells, churn drills are used to penetrate the 500 to 1,000 feet or more of sediment overlying the salt formation; and when the formation is reached a diamond drill is utilized for coring in the salt. It is reported that coring of the potash-bearing salts in all wells has been successful, 100 per cent of the drilling footage having been obtained as core in all the tests made in Texas. This is an enterprise of the utmost economic importance; and we look forward with great interest to the disclosures that may be made during the current year.

DAILY DOZEN FOR THE EYES

CAN we do without our glasses? Can a large percentage of us so strengthen our eyes by muscular exercises that artificial aids to sight can be abandoned? Affirmative answers to these questions were made not long ago by members of the New York State Optometric Association during a convention in the Metropolis.

Broadly stated, the principle is a familiar one; and allied applications of it are matters of common knowledge. Nature tells us repeatedly that health is dependent upon exercise, and that normal vigor depends upon the more or less frequent or systematic

utilization of our muscles. Without that exercise, the muscles lose vigor, and dependent functions become correspondingly impaired or imperfect. A sprained ankle will never become strong again if a crutch be used to save it; the broken arm will mend but it will never return to its former working capacity if humored and denied full exercise. The eye does not differ in principle from the ankle or the arm, because its functional perfection is dependent upon the state of the muscles that control it, either voluntarily or involuntarily. In short, the use or misuse of glasses may, in the end, hurt more than help by doing or lightening the work that some of the muscles should perform.

It is conceivable that well-directed and systematic exercises may so restore the functional vigor of the eye as to make dependence upon glasses, under certain circumstances, no longer necessary; but where are we to get guidance in this matter? Manifestly, the decision should not be left to our own wisdom, because the eye is a complex and a rather delicate organ. Furthermore, there are physical shortcomings in some eyes that make the wearing of glasses unavoidable; and no amount of exercise will alter or remove those defects. Just the same, it may be practicable to help the eyes of many of us by taking regularly certain prescribed exercises; and these may serve to so strengthen the eyes that glasses can be laid aside or used but infrequently.

BURNED-OUT ELECTRIC BULB NOT A TOTAL LOSS

THE New York Edison Company has devised a machine, that it calls a rumbler, for removing brass shells from burned-out electric lamps. Most establishments consider such bulbs waste material and throw them away; but the company in question collects about 300,000 in the course of a year from its various offices, warehouses, power plants, etc., reclaims the brass, and sells it as scrap metal.

Until the use of the motor-driven rumbler, the work was done by hand churning—a dasher worked up and down in a barrel. Now, anywhere from 300 to 500 lamps, of all sizes, are dumped into a perforated steel cylinder into which are loosely placed two steel bars having numerous prongs. As the cylinder revolves at high speed in a tubular container, the prongs break away from the shells all glass, filaments, wires, and even cement, the fragments dropping through the holes into a steel drawer. The brass shells left in the cylinder come out clean and bright, therefore bringing a better price than those formerly salvaged by the hand method.

What may or may not be a record shipment so far as length is concerned was made recently by the Hedges-Walsh-Weidner Company and consisted of a tank 140 feet long and 8 feet in diameter built for pressure creosoting. Completely assembled, the unit weighed between 150 and 200 tons, and was carried to its destination on five flat cars.

EARLY MISSISSIPPIAN FORMATIONS IN MISSOURI, by Raymond C. Moore. An illustrated work of 298 pages, issued by the Missouri Bureau of Geology and Mines, Rolla, Mo.

THE Mississippian formations are among the most important stratigraphic series in Missouri. Apart from their mute evidence to what happened on this continent many ages ago, the formations are of present economic significance because they contain some of the most valuable mineral deposits in the state. Furthermore, certain of the Mississippian rocks can be utilized for building stone, as a source of lime and cement, and for crushed rock for many purposes. The present work, officially known as Volume XXI, 2nd Series, can be secured by applying to H. A. Buehler, director and state geologist, Missouri Bureau of Geology and Mines.

THE BUREAU OF BIOLOGICAL SURVEY, by Jenks Cameron. A work of 339 pages, published by the Johns Hopkins Press, Baltimore, Md. Price, $2.00.

WHILE the Bureau of Biological Survey of the Department of Agriculture might not inaccurately be described as the natural-history agency of the American Government, still its field of service is so varied in its many different contacts that this designation fails because of lack of comprehensiveness. In a legal sense, the survey dates from 1885, when Congress made biological work an established, continuing, uninterrupted part of the agricultural day's work of the Government instead of the semi-occasional thing it had previously been. Besides studying the wild life of the country and seeking to maintain "a balance of nature", one other function—and a very important one—of the survey is to look to the future and to contribute to the continued well-being of our economic life by fostering a wider understanding of the interrelation between domesticated creatures and wild creatures.

THE UNDEVELOPED MINERAL RESOURCES OF THE SOUTH, by Henry Mace Payne. A book of 368 pages, published by the American Mining Congress, Washington, D. C. Price, $5.00.

THIS book was not undertaken for profit but to supply a comprehensive exposition of the mineral resources—developed and undeveloped—of thirteen southern states ranging from Virginia to Texas. The inspiration for the work lay in the well-founded belief that the prosperity of a country or a section of a country can, to a large extent, be gaged by the magnitude of its mining industry. The volume should be of great value to the people of the South in developing their natural resources so as to draw upon, as far as possible, their own available raw materials both for their own use and for disposition elsewhere. Conversely, the information compiled by Doctor Payne should be extremely helpful to capitalists and others looking to the South as a field of service and a section encouraging to business or industrial undertakings of divers sorts. The author has done an excellent job.

INTRODUCTION TO THEORETICAL PHYSICS, by Leigh Page, Ph.D., Professor of Mathematical Physics, Yale University. An illustrated volume of 587 pages, published by D. Van Nostrand Company, Inc., New York City. Price, $6.50.

THIS book is based on a year's course of five lectures a week given by the author at Yale, and is designed as a textbook for first-year graduate students and for college seniors who are specializing in physics. The aim is to provide the student in an elementary way with a survey of the whole field of theoretical physics. The author states in the preface that his endeavor has been throughout the book to furnish a clear and logical presentation of the subject rather than merely to impart information.

Abstracts of Scientific and Technical Publications from the Massachusetts Institute of Technology, No. 1 and No. 2, respectively, January and July, 1928, have been published by the Technology Press, Cambridge, Mass. The publications dealt with cover aeronautical engineering, biology and public health, chemical engineering, economics, electrical engineering, fuel and gas engineering, mechanical engineering, mining and metallurgy, mathematics, naval architecture and marine engineering, physics, etc., etc.

Torsion, Impact and Other Mechanical Properties of SAE-3130 Nickel-Chrome Steel is the title of an 8-page bulletin issued by the International Nickel Company, Inc., New York City. It contains the results of extensive tests; and the data are presented in the form of charts and tables with explanatory comment

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Trade Standards, Third Edition. An illustrated booklet published by the Compressed Air Society, New York City. Price, 50 cents.

Tractive Resistance of Automobiles and Coefficients of Friction of Pneumatic Tires, by T. R. Agg, highway engineer, has been issued as Bulletin 88 by the Engineering Experiment Station, Iowa State College, Ames, Iowa. This bulletin contains much helpful data presented in a lucid and interesting manner. It should be of value to all persons having to do with this subject—one of continually increasing importance.

What Mining Means to Utah is the title of an illustrated brochure of 54 pages issued under the auspices of the Chamber of Commerce of Salt Lake City, Utah. This pamphlet is a compilation of papers prepared during 1927-28 and presented to the citizens of the State of Utah in an effort to give them a detailed picture of what mining means to them as an employer of labor and as a consumer of products grown or manufactured within the state.